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CONTENTS.

	PAGE.
EDITORIAL:	
Paragraphs	57
ILLUSTRATED ARTICLES:	
A Compact Isolated Plant	59
The Dubuque (Ia.) Storage Battery Street Railway, by Fred De Land	61
A Portable Electric Lighting Plant	63
A Carbon Filament in a Transparent Vacuum Chamber, by A. M. Tanner	65
On a Modified Form of Wheatstone's Bridge, by R. A. Lehfeldt	65
Pocket Electrometers	65
On the Mechanical Actions of Electrical Waves, by H. Hertz	66
The Holzer-Cabot Fan Motor	67
The Hercules Electric Motors and Dynamos	67
Radway's Feed-Water Heater and Purifier	67
The Edison Electric Mining Pump	67
The Bleakley Door Hinge Alarm	68
A New Self-Winding Clock	68
MISCELLANEOUS:	
Latest Foreign Electrical News	58
Freund's Moonlight Tables	58
Electrical Installations in Dubuque, Ia	58
Electrical Practice in Europe as Seen by an American.—I.	58
The Most Economical Loss in Conductors.—II. By Prof. E. P. Roberts	58
History of Electricity, by P. F. Mottelay	59
A Point of Economy in the Working of Electric Light and Power Stations, by Leonard Paget	62
Telephone Service in Boston	63
Cost of Electric Traction	63
The Dielectric Properties of Mica at High Temperatures	63
Opinions on the Edison Decision	64
FINANCIAL INTELLIGENCE: The Electrical Stock Market, 68; New Incorporations, 68; Affairs of the Companies, 68.	
SPECIAL CORRESPONDENCE: New York Notes, 68; New England Notes, 69; Western Notes, 69; Southern Notes, 69; English Notes, 69.	
ANSWERS TO CORRESPONDENTS	69
NEWS OF THE WEEK: The Telegraph, 70; The Telephone, 70; The Electric Light, 70; The Electric Railway, 70; Personals, 71; General Applications of Power, 71; Miscellaneous Notes, 71.	
INDUSTRIAL AND TRADE NOTES	71
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS	72

Our Correspondent Abroad. In another column we give the first of a series of communications on electrical practice abroad that we trust will prove of considerable interest to our readers. As announced some time since, Mr. Carl Hering was sent to the other side of the water by THE ELECTRICAL WORLD as special correspondent with a view of obtaining full and complete information regarding the Frankfort Exposition, and also such further details of important electrical enterprises abroad as would be of value to engineers here. Mr. Hering's letter just received gives some of the inside facts concerning the new rapid transit enterprise in London, of which mention has been made from time to time in our columns. We can hardly appreciate here the difficulties with which our English cousins have to contend in the way of unreasonable and stubborn opposition from unexpected quarters, and it is a matter of great satisfaction that common-sense has at last triumphed and electric rapid transit in London on an extensive scale is now an assured fact. Mr. Hering will continue giving full and fresh information concerning European electrical undertakings, and will shortly arrive at the electrical exposition, where he will take a prominent part in the proceedings of the electrical congress, as he has done previously on more than one occasion.

At His Old Tricks Again. THE festive reporter with the electrical imagination has been comparatively quiet during the past few weeks, possibly summering in the backwoods of Vermont, from which, however, he has now returned with a rejuvenated brain and a fresh stock of myths. His latest effort is a weird and fanciful tale of a cat electroplated by lightning. In a distant and inaccessible Vermont village, so the story goes, on the wall of a venerable and stately mansion hangs a choice collection of revolutionary swords, and beneath is a sofa of the olden time where the family cat lay curled up, dreaming, perchance, of the rodents whose euphonious designation is perhaps the best comment on the story. A frolicsome flash of lightning entered, vaporized the silver hilt of one of the swords, and deposited it in a smooth and even layer over the unfortunate feline beneath. It is too bad that the cat is said to have been killed, for a perambulating piece of silver plate would have made the fortune of the owner if sublet to a dime museum. The marvelous artistic possibilities developed by this extraordinary occurrence are worthy of more than a passing glance. If lightning could be conveniently controlled, what a solace to bereaved maidens of uncertain years would be the fine silvery images of their favorite pets placed upon the mantel; what beautiful electroplated cabbages could be exhibited at county fairs. Perhaps sooner or later we might be treated to the incorporation of the Universal Mammalian Electro Deposition Company, with a capital stock of twenty-five millions in ten-cent shares. What a magnificent outcome it would be from the scorched and partially silvered wreck of an otherwise useless tabby cat!

The Incandescent Lamp Decision. LAST week we had the pleasure of presenting to our readers the full text of Judge Wallace's decision in the incandescent lamp suit, publishing it not only ahead of all other technical journals, but earlier even than any of the daily newspapers. The effects of the decision were manifested immediately by a sharp rise in Edison stock and a corresponding, although much slighter, fall in some other electrical securities. Incandescent-lamp manufacturers necessarily feel somewhat discouraged at the turn affairs have taken, and the Edison company is correspondingly elated. The contest over the incandescent lamp patents has been exceedingly interesting, and the end is not yet, although the present victors have the advantage always due in legal matters to several favorable decisions. The case will undoubtedly come before the Circuit Court of Appeals for review, but whether it can be carried after that to the United States Supreme Court is a matter of considerable doubt, as the Circuit Court of Appeals was organized largely for the purpose of relieving the superior tribunal from the burden of work that had been put upon it. A final establishment of the Edison patent would fall most severely on the smaller manufacturers. There are perhaps a dozen lamp factories in the country producing a comparatively small output, generally, however, of lamps of excellent quality. The operations of these companies could be severely interfered with if the Edison company should choose to do so, and it is to be hoped that in case of ultimate success that organization will pursue a sufficiently liberal policy to insure a continuance of the present rapid development of the incandescent lamp industry. Such a course would prove a benefit in the long run to all the parties concerned.

Wheatstone Bridge Methods. ELSEWHERE we give an article on the management of the Wheatstone bridge that will probably prove of interest to many of our readers. In brief it consists of using a resistance box in shunt with one of the fixed arms of the bridge, and is therefore capable of facilitating fine adjustment when an expensive bridge box is not at hand. With three fixed coils and a resistance box it is possible to do very neat work, thus putting a bridge method of considerable accuracy in the hands of those who cannot otherwise readily avail themselves of it. There are many laboratory devices comparatively little known, but very handy, that lend themselves readily to practical work; indeed not a few of them are in use to-day, but are known to a comparatively small circle. Another neat arrangement for bridge-work, where elaborate apparatus is not at hand, consists in withdrawing the "infinity plug" of an ordinary resistance box used as a variable arm of the bridge, and grasping in the binding posts the ends of a bit of German-silver wire which, by loosening one contact, can be adjusted to the proper relation very rapidly and easily. This wire need be of no particular size. It is only necessary that its resistance should be known; a convenient way of arranging it is to measure off a length equivalent to one ohm resistance, then make a little measuring stick of equal length and divide it into 100 equal parts. A simple reference to this will enable the resistance to be found to the one-hundredth part of an ohm very quickly and without any figuring. In preparing the ohm wire it should have a copper terminal soldered to one end, to eliminate the uncertainty of one of the contact resistances. It would be a great advantage if working electricians would hold now and then little experience meetings in print, and exchange the various wrinkles that prove convenient in every-day work.

Electricity in Mining. THROUGH the past few years the employment of the electric motor in various forms has increased with prodigious rapidity, but there is one field—that of mining—in which it has slipped by such insensible degrees that most persons scarcely realize that it is now, or is likely soon to become, an important factor in mining operations, but such is the case. Probably there are not less than 40 mines in the country to-day using electricity for light or power, or both, and the number is slowly but very steadily on the increase. As a means of distributing power from a single source of energy electricity knows no rival. It has the enormous advantage over compressed air of requiring light and easily shifted temporary connections with the primary source of power, and beside this the distribution is decidedly more efficient. In certain localities throughout the mining regions of the West there are numerous places where fuel is costly and difficult of access, but where in its place nature has provided an inexhaustible source of power in waterfalls. A fine example of this sort at Telluride, Colo., was described in THE ELECTRICAL WORLD a few months ago. There are to-day not a few mines that have been abandoned as unprofitable on account of their unfortunate situations, where, by a little engineering skill, the neighboring streams could be utilized to furnish all the necessary power and bring the deserted shafts into active use again. Only recently electric drills for stone quarries have been brought into use, and even now promise to find no small amount of employment. Aside from these very obvious uses of electricity in mining work there are others not so often considered, but in themselves interesting. As an example, there is a possibility of locating native metal by means of the induction balance, a suggestion that was brought to our notice by a mining engineer some little time since. Of course in a large number of cases such an application could not be made, but in the one our informant contemplated it would have been eminently feasible, as the metal was native copper occurring in chimneys in a rather hard rock. As the field becomes more fully occupied plenty of applications now unthought of will suggest themselves to the mind of the engineer, and the time is not far distant when electricity will play almost as important a part in mining as it does now in street railway service.

A Pertinent Lesson. IN another column may be found some exceedingly instructive figures regarding the relative economy of traction by electricity and by horses. The statistics are derived from the official report of the West End Street Railway system of Boston for the months of April and May last, and they are not only the latest figures available for the purpose of making such comparison, but are on a scale of sufficient magnitude to be worthy of considerable confidence. Looking at the figures in a general way the most striking fact is the immense difference in net earnings between the electric and horse cars, the former being nearly double the latter. In April the electric cars, at a cost for total expenses per mile of 21.75 cents, earned 12.03 cents per mile for the company; in May both these figures were increased to 22.36 cents and 16.07 cents. Now glance at the performance of the horse cars in April. The cost per mile was 25.55 cents and the earnings only 6.22 cents. In May the total expenses per mile run fell to 24.62 cents and the earnings rose to 9.06 cents. These are striking figures, doubly so when one remembers that the monthly car mileage for the horse cars was more than 1,000,000 as against less than 400,000 for the electric cars. Were these figures reversed the effect on the net profits of the road would be something prodigious. A brief computation on the basis of the statistics given shows that the increase in the earnings would be more than $46,000 per mile, a sufficient amount to pay the interest on heavy investments for plant and still leave a comfortable margin for the delectation of the stockholders. Looking at the expenses in detail it appears that the cost of motive power by electricity is only about eight-tenths, per mile run, of that incurred with horses: the car repairs are somewhat greater, the cost of conductors and drivers very perceptibly less, owing to the greater speed of the cars. The system is as yet not completely equipped electrically, and hence labors under some disadvantages. It is calculated that when the power-houses are completed and the system in full operation that the total expenses per car mile will fall to 20 cents or even less, while the increasing use of long and capacious cars on double trucks will very considerably increase the gross receipts. The West End system is the largest in the country using electricity as motive power, and there has been ample opportunity for judging of its practicability and relative economy. Doubters to the contrary notwithstanding, the electric system in Boston has proved thoroughly satisfactory, has increased the available portion of the suburbs to no small extent, has quickened the time of transit from one part of the city to another, and has actually proved itself not only a great public convenience, but, in spite of sneering criticisms, has demonstrated that it is actually safer than the old reliable horse car of which the New York public seems to have become thoroughly enamored. Statistics of accidents on the West End system have shown that the relative number caused by electric and horse cars is about the same, but that with the electric cars a noticeably smaller proportion of these accidents have resulted in injury to human beings; proportionately more vehicles have been damaged by cars but decidedly fewer lives imperiled. And now comes this latest statement showing as plainly as figures can show that the horse must go; for when his commercial usefulness is destroyed, as it has been by the electric motor, sentiment will not keep him at his labor. In fact any one with the ordinary feelings of humanity would far rather be carried to his destination by an insensate motor than by toiling horses belabored with imprecations at every other step, and destined to a short life by the severity of their work.

Latest Foreign Electrical News.

(By cable from our own correspondent.)

London, July 20, 1891.—The British Association for the Advancement of Science holds its annual meeting at Cardiff about the middle of August, and one of the features of the meeting will be a discussion of units of measurement and nomenclature, with special reference to the electrical units.

Some very interesting experiments were tried on Tuesday last at the Willans Works, and resulted in the demonstration of the possibilities of running Mordey alternators in parallel when coupled direct with Willans engines. The feasibility of such a scheme has been often disputed, but the experiments of Tuesday put it beyond question. As our practice here includes the frequent running in parallel of such machines, the commercial value of the work just completed is evident.

The strong prejudice against the overhead system of electric traction is being somewhat modified here, as evidenced by the commission just granted to the Wallsall municipality for the construction of an electric tramway on the trolley system. Speaking of electric permits, the Board of Trade announces the granting of 58 franchises recently to 34 municipalities and 24 private companies. The total number granted since 1883 is 218, of which 157 still remain in force. During the past 12 months the laying of 137¼ miles of electric lighting mains has been sanctioned hereabouts, 86 of these being for alternating currents, and the remainder for the low-pressure system of distribution. The thing specially noticeable about the recent permits is the large number of municipal stations that are in progress.

After considerable deliberation the St. Pancras vestry has decided to adopt for street lighting the Brockie-Pell system of arc lamps, which have been extensively used in this country.

Moonlight Tables for August, 1891.

Herewith we give Mr. H. W. Frund's table of lighting hours for the month of August, under his modified form of moon schedule.

TABLE NO. 1.
Standard Moonlight, Philadelphia System.

Date.	Light.	Date.	Exting.
1	7:45 P.M.	2	4:00 A.M.
2	7:45	3	4:00
3	7:40	4	4:00
4	7:40	5	4:00
5	7:40	6	4:05
6	7:40	7	4:05
7	7:35	8	4:05
8	7:35	9	4:05
9	8:45	10	4:05
10	9:05	11	4:10
11	9:30	12	4:10
12	9:55	13	4:10
13	10:30	14	4:10
14	11:10	15	4:10
15	12:00 M.	16	4:10
16			
17	1:00 A.M.	17	4:15
18	No light.	18	No light.
19	No light.	19	No light.
20	No light.	20	No light.
21	7:15 P.M.	21	9:20 P.M.
22	7:15	22	9:45
23	7:15	23	10:15
24	7:15	24	10:45
25	7:15	25	11:15
26	7:10	26	11:55
27	7:10	28	12:40 A.M.
28	7:10	29	1:30
29	7:05	30	2:25
30	7:05	31	4:25
31	7:05	1	4:30

Tot urs lighting, 170.10.

TABLE NO. 2.
Frund's New Moonlight System.

Date.	Light.	Date.	Exting.
1	7:45 P.M.	2	4:00 A.M.
2	7:45	3	4:00
3	7:40	4	4:00
4	7:40	5	4:00
5	7:40	6	4:05
6	7:40	7	4:05
7	7:35	8	4:05
8	7:35	9	4:05
9	7:35	10	4:05
10	7:30	11	4:10
11	7:30	12	4:10
12	7:30	13	4:10
13	7:25	14	4:10
14	7:25	15	4:10
15	7:25	15	12:00 M.
16	7:20	16	12:00
17	7:20	17	12:00
18	7:20	18	12:00
19	7:20	19	12:00
20	7:15	20	12:00
21	7:15	21	12:00
22	7:15	22	12:00
23	7:15	23	12:00
24	7:15	24	12:00
25	7:15	25	12:00
26	7:10	26	12:00
27	7:10	28	12:40 A.M.
28	7:10	29	1:30
29	7:05	30	2:25
30	7:05	31	4:25
31	7:05	1	4:30

Total hours lighting, 213.45.

Electrical Installations in Dubuque, Ia.

The Key City Electric Street Railway Company is operating the Sprague-Edison system, and has one No. 20 Edison generator of 50,000 watts capacity, driven by a Rice automatic engine. Four motor cars are employed on the two and one-half miles of track, which is a series of grades from beginning to end, with sharp curves at the top of each rise. The duty required is too heavy for the light equipment, and heavy machinery will be installed. Mr. Joseph Angell is the efficient superintendent.

The Dubuque Electric Railway, Light and Power Company is also operating the Sprague-Edison system, has 10 miles of track, 12 motor cars with 30 h. p. motors and six trailers. The maximum grade on the line is nine per cent., and sharp curves are numerous. The road has been in operation about 13 months, is giving excellent satisfaction, and has greatly developed the section through which it runs. The power required in driving the cars is supplied from the same station furnishing electric lights (the carhouse adjoining the station), which is complete and commodious in its arrangement, and contains two Edison No. 20 generators of 50,000 watts capacity; one Thomson-Houston alternating current machine of 1,350 lights capacity, and one of 750 lights, and three 50-light, 2,000 c. p. Thomson-Houston arc dynamos. The dynamos are belted directly to four Meyer engines, three of 165 h. p. and one of 195 h. p., built by the Davenport Foundry and Machine Company, of Davenport, Ia., the necessary steam being supplied by five Heine boilers 60 inches by 16 feet, having 54 four-inch tubes, the steam passing through a Stratton separator to the engine and returned to the boilers through a Westinghouse, Church, Kerr & Company's steam loop. A Stillwell & Bierce No. 9 live steam purifier is used and its service spoken of in the highest terms, for the water used is taken from an artesian well and the amount of lime deposited is very great.

Electrical Practice in Europe, as Seen by an American.—I.

THE CENTRAL LONDON RAILWAY.

The House of Lords and the House of Commons have just passed the bill for the Central London Railroad (an underground electrical road), and it now awaits only the royal signature, which, I am told, will be received without doubt. Until now this bill was said to have been effectually defeated by the clergy, whose influence is very great here, even greater than in the United States. It adds to the list of unexpected obstacles and hindrances which promoters of electrical enterprises have to contend with here. The apparent excuse for this interference was that such an electrical road would make the church steeples topple over! It is a matter of conjecture, however, whether, under the cloak of the clergy, there was not the influence of the competing lines of traffic which already exist, and which would be affected by this new road. If so, it is an indirect acknowledgment on the part of such companies (steam roads, 'busses and tracks) that the present electrical underground road from the city to South London is such a success that a similar road would be a dangerous competitor. It is quite likely that the fact that the present road is a success, as far as the public are concerned, is one of the chief features that led to the passage of the bill in both Houses. The passage of this bill, and the fact that the enterprise is undertaken by the same parties who started the other road, is therefore significant in more ways than one. Furthermore, if the present road did not show that it would be a financial success, it is hardly likely that a second and larger one would be started.

This new road is to extend between Shepherd's Bush and the Royal Exchange, a distance of about six miles, under Cheapside, Holborn Viaduct, Oxford street, etc., which is the main artery running east and west through the heart of London. There is said to be more traffic there than in any other thoroughfare in the world, Broadway in New York included. This route forms a sort of diameter of the circular route made by the present underground steam road. As a line of travel it is very similar to Broadway in New York.

The tunnel will be chiefly under streets, at an average depth of 60 to 70 feet under the street, passing under the present underground steam road in two places. The tunnel will be 11 feet 6 inches in diameter, which is larger than that of the present road by 18 inches. This will enable the cars to be larger and more comfortable. The present cars, though small, are not too much so to be uncomfortably cramped. The cars are cylindrical, fitting the tunnel quite closely. A train will carry 350 passengers (seated), and will run on three-minute time instead of 100 passengers on four and a half minute time, as on the present road. The present road does not pass through a district there where is as much traffic as in the line of the new road.

It is very significant and instructive to notice what changes in the construction are to be made in this new road as compared with the present one, the promoters being the same. Anyone interested in such roads will do well to compare the two roads in detail, when such detailed descriptions are published. At present such information is scarce. It appears that the general features will remain about the same. The feature of having two independent motors on the locomotive, one for each pair of driving wheels, is said to be very satisfactory; one of these motors is said to be able to run the train alone in case the other is disabled. One of the principal changes is that there will be a separate system of mains for the lighting of the stations and tunnels, and probably the cars also, so as to avoid the very annoying and unceasing changing of the brightness of the lights. The brakes will be operated by compressed air carried on the locomotive, and supplied at the end stations as at present; electric brakes are claimed to be so much more complicated than air brakes. The strange feature in the present road of running the large elevators at the stations by hydraulic pressure, transmitted through miles of pipes from the generating station, will probably be changed in the new road, in which electrical elevators will probably be used. To an American so accustomed to electrical elevators it seems strange that this was not done on the present road instead of making the system more complicated by the introduction of a second system of transmitting power which, it would appear, is more complicated and more liable to failure than the electrical transmission for which the circuits exist. If the latter is relied upon for propelling the trains, why should it be less reliable for running the elevators? Hydraulic transmission surely cannot be cheaper.

For some of the above information regarding the engineering features of this new road the writer is indebted to Mr. F. Schute, one of the engineers in the office of Mr. J. H. Greathead, the engineer. It may be remembered that Mr. Greathead is one of the consulting engineers for the Hudson River Tunnel.

Carl Hering.

London, July 10, 1891.

The Most Economical Loss in Conductors.—II.

BY PROF. E. P. ROBERTS.

Some of the considerations affecting the determination of the most economical loss in electric conductors, first, in constant current circuits, and second, in constant, or almost constant, potential circuits, may now be studied. The latter case is subdivided into:

(*A*) Direct or alternating current circuits, delivering the current direct to the translating devices* without the intermediary of a converter.

(*B*) Alternating current circuits delivering the current to converters or transformers, the current derived therefrom being that passing through the translating devices.

It is perfectly evident, even after a very cursory examination of the problem: (1) That the less the resistance of the conductors the less the energy necessary to be developed by the source of power in order to deliver a certain amount of energy to the translating devices; and (2) that the less the resistance of the conductors the more they will cost and, therefore, the greater the interest and depreciation to be charged to the wiring account. It is assumed that joints, insulation, etc., are practically perfect and, therefore, the only way to lower resistance is to increase the cross section of the conductor. The form of the cross section it is not necessary, in this connection, to consider.

It is not difficult to take another step and perceive that there must be some certain sized conductor which will be more economical than any other, in so far that if any increase is made beyond that size, more is paid for the energy saved than it would cost to produce such energy, and also that if any smaller conductor be used then the cost to produce the additional energy needed to overcome the additional resistance would be more than the difference between the sum of the interest and depreciation accounts of the wire considered as the standard and such smaller wire.

In 1881 Sir William Thomson enunciated the principle underlying the study of the determination of the most economical size of conductor for any given case. It is "that the greatest economy is obtained when the money value of the heat wasted in the conductors equals the allowance for their depreciation and interest on their cost." The rule is simple, and tables have been prepared which make its application very easy, but the unfortunate fact exists that, for the great majority of cases, the practical considerations involved may, and generally will, affect the problem to such an extent that any result obtained from using the formula is practically useless.

An example will assist in showing how such practical considerations may affect a result obtained from theoretical considerations.

Example.—A certain line is to be used eight hours per day, for 300 days in a year; copper costs $1,000 per ton, in place; the amount to be allowed for interest and depreciation is 10 per cent.; the cost of one electrical h. p delivered to the line is three cents. Determine the amount of energy which should be lost in the line to use copper to the best advantage.

Interest and depreciation at 10 per cent. = $100., and 300 (days) × 8 (hours) = 2,400 hours.; therefore, the cost of the energy lost per hour (constant current) should be 10,000 ÷ 2,400 = 4.16 cents. Divide 4.16 by 3 (cost of one h. p.), and 1.39 h. p. is the result.

This seems very simple, but the difficulty lies in the determination of the figures to be used, and even the above very simple case will be found to be full of difficulties if an effort is made to apply the method to an arc circuit. For constant current circuits the length of time in use and, therefore, the energy lost per ton of copper for any wire and current can be determined. The next item considered in the example is more difficult. The cost per ton of copper in place is not a constant. For a certain locality, and with a given character of installation, the cost of the copper may be 75 per cent. of its cost in place, and for some other locality it may be only 20 per cent. In order to determine the allowance for depreciation, judgment, based upon facts obtained from other installations, must be exercised. Often the total amount for interest and depreciation will be almost constant. For instance, if the rate of interest be known, the more money put in to make a good permanant installation the greater the interest account but the less the depreciation.

Particularly is this true of pole work. If good poles, and enough of them, and well insulated wire, properly connected and fastened, be used, then the depreciation will be less than if the reverse be the case. The cost of repairing a pole line has often for its greater portion the cost incident to the setting of poles to take the place of old ones and the transferring of wires thereto; the cost of the pole being a relatively small amount.

Evidently if one line of poles can be used to support two or more wires, the cost of copper in place will be less than with one line of wires to a line of poles. Also the cost of placing the wire in city streets will be many times that in the country, and the cost of putting underground much more than that of placing overhead, with the possibility, in some degree, of less depreciation. The cost of copper per pound of conductor *in place* may be anywhere between

* The term "translating device" is used to indicate the apparatus by passing through which the electric energy is converted into some other desired form; for example, power from a motor and light from either arc or incandescent lamps.

30 cents and $1.50, or even more, the depreciation depending largely upon the character of the installation, and often being less for the more expensive plant. The cost of one electrical horse power is made up of two factors—first, the cost of one h. p. delivered to the dynamo, and, second, the cost of transforming the mechanical into electrical energy. Each of these items can, generally, be predetermined, with a fair degree of accuracy, for any given plant, if the figure desired be the quotient obtained by dividing the total amount of the above two items for one year by the total electrical horse power developed. Such a figure is not, however, of proper application in any given case. What is really desired is, given a certain energy developed, how much more will it cost to develop additional energy, and how much will be saved if less be developed? Included in this consideration must be the question as to whether variations in the units of power and electrical apparatus are possible, to the extent desired, and, if so, whether they, from other standpoints, are advisable.

The following discussion of the above points is designed to indicate the method of determining the size of conductor which is most economical for any given case. Usually the most economical size will be most desirable, but special conditions may arise which will render a certain portion of a circuit necessarily of a given size and other portions may thereby be modified. In a case in practice the first fact to determine is the energy to be furnished the translating devices during each and every hour. From such data an output curve can be constructed, and the average loss, for any size wire, determined. Two cases arise in practice, one constant current and varying "P. D." at the generator terminals; the other, varying current and usually only sufficient variation of "P. D." at the generator terminals, or at the station end of the feeder wires to maintain constant "P. D." at the translating devices, or at some point as near to them as practicable.

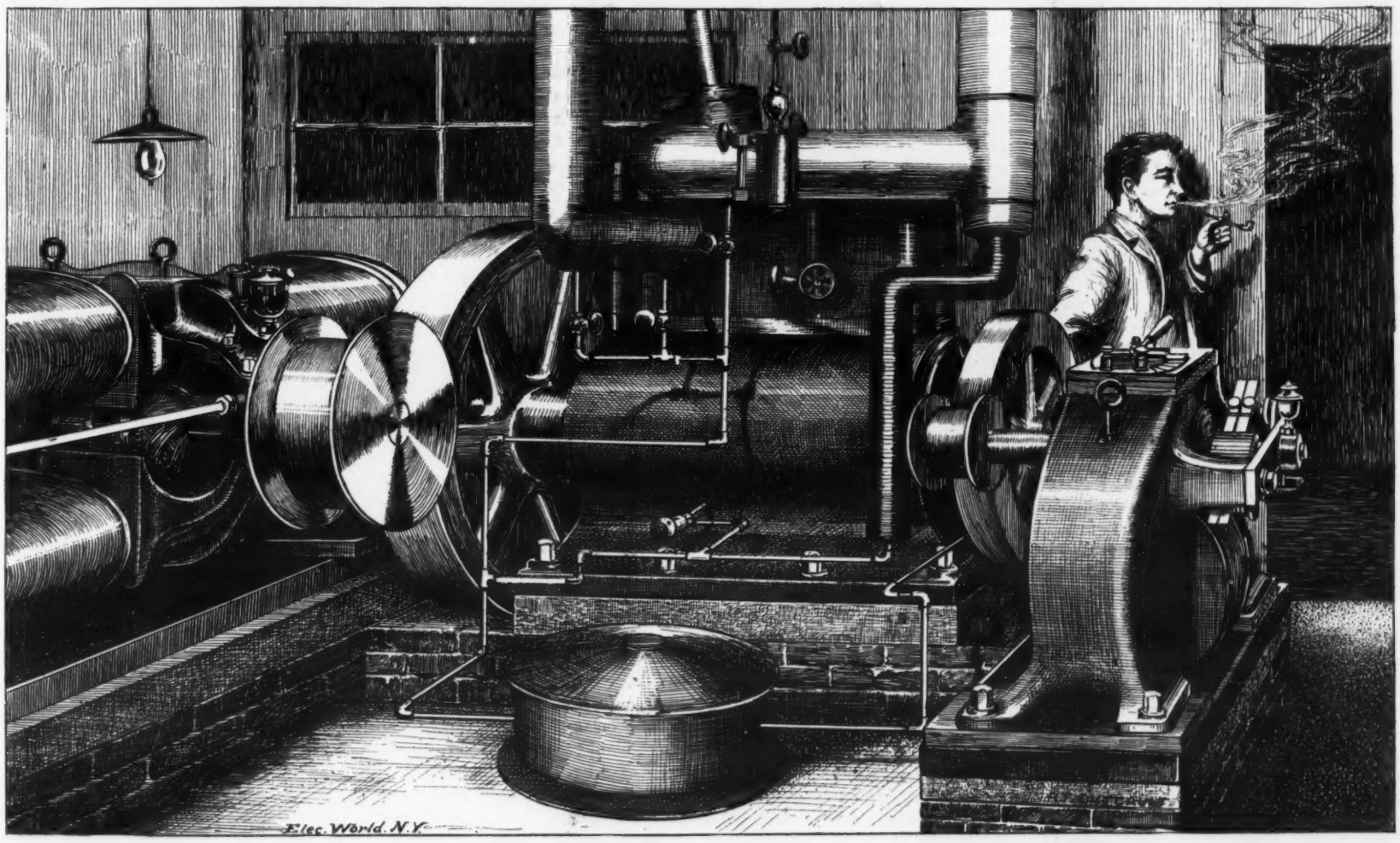
Example.—Constant current and varying "P. D." at station terminals. Suppose a constant current of 10 ampères be desired, and 50 arc lights, requiring 50 volts each, be energized during all the time current is supplied. The ratio of the energy lost in the line to the total energy will be constant, and the determination of the total amount of energy lost in the line, for any given size of wire, is a simple problem. If, however, the load varies, then the conditions render the determination of the energy lost somewhat more difficult. Suppose the average conditions to be as represented by the following table:

1 Time.	2 No. of lights	3 Line "R."	4 "PD." of line in volts.	5 "PD." of lamps in volts.	6 Total volts.	7 Per cent. of voltage or energy lost on line.		8 Average between hours.
6 P. M....	50	5	50	2,500	2 550	.96	1.96	1.96
7 "	50	5	50	2,500	2,550		1.96	
8 "	40	5	50	2,000	2,050	1 96	2.44	2.20
9 "	30	5	50	1,500	1,550	2.44	3.19	2.81
10 "	20	5	50	1,000	1,050	3.19	4.86	4.02
11 "	10	5	50	500	550	4.86	9.09	6.97
12 "	10	5	50	500	550	9.09	9.09	9.09

If No. 6 wire be considered $R = .0004$ of an ohm per foot and the circuits be 12,500 feet long, then the total R will be 5 ohms, as shown in column 3. The "P. D." required to force 10 ampères through the line is evidently 50 volts—($E = C R$). The "P. D." required for the lamps is as per column 5. The total "P. D." is as per column 6. As a constant current is flowing the energy is proportional to the "P. D.," and, therefore, the percentage of energy lost in the line is as per column 7, and the average loss as in column 8. Comparing columns 6 and 7, it is evident that for series circuits the efficiency of the system is increased by each additional translating device, provided the same be in constant use. If they are not in constant use the efficiency is lowered, and one practical deduction is that for constant current circuits, it is sometimes best to use a number of comparatively small dynamos, and thereby obtain a constant full load for each dynamo, each supplying current within a limited area. This also lessens the liability to any extended breakdown, and obtains many other advantages, such as ease of testing, less liability of burnouts, etc. On the other hand, the dynamos will cost more for a given total capacity and need more pulleys and greater total floor space.

As above stated, it is sometimes better to use several small dynamos rather than a large one supplying current for a very extended territory and having a variable load. An approximation to the above is made when a number of circuits are brought to the switchboard and connected in series on one dynamo, and any circuit being cut out when desired. With constant potential and variable quantity circuits the conditions are very different from the above, and such a case is hereafter explained.

Returning to the example, the loss in the line is 250 watts ($C \times E$), and if the cost of copper in place, for the case under consideration, be known, it might seem very easy to determine what the cost of power per horse power, or per watt, would be in order that No. 6 wire (generally used for such circuits) might fill the requirements of Sir Wm. Thomson's rule. Such is not, however, the case, as the cost to produce more or less power than a certain specified amount does not bear any definite relation to the cost of such amount. Therefore if in an actual case five per cent. be the loss incurred, then to double the loss may not make the total cost two per cent. or even one per cent. more, and to study the actual conditions which arise a further and more detailed examination is needed. A study of the following case, with the conditions specified, will give some insight into many of the points which should be considered. Often such matters are slightingly called "theory," but results show that the practice of theory, based on facts, brings returns in cash.



A TROY (N. Y.) ISOLATED ELECTRIC LIGHTING PLANT.

A Compact Isolated Plant.

One of the neatest little electric lighting plants that it has been our fortune to see is the one illustrated herewith. It is packed away in the basement of the drygoods house of Andrew Church & Co., in Troy, N. Y., and is almost unique in the small space occupied. No room was available except a little cubby hole 6 feet by 10 feet 6 inches, and a narrow passageway a few feet longer. It seemed at first impossible to install the plant required, but finally E. G. Barnard & Co., electrical engineers, of Troy, were instructed to go ahead and put in the plant if they could. Our cut shows how the feat was accomplished. In the middle of the room was placed a 25 h. p. Westinghouse engine. There was no room for belts, so Evans friction cones were fitted to the dynamos instead, and these were adjusted to each driving wheel of the engine. The dynamos are two in number, one a U. S. 20-light arc machine, the other a U. S. motor type incandescent dynamo of 50 lights capacity. Between these three machines the floor space was fully occupied, as the passageway was utilized and a long and lean boiler of locomotive type of 30 h. p. was crowded into it. This is fitted with a Körting injector, and room was also found for a little Worthington steam pump. The exhaust steam is utilized for heating purposes. The plant has been in use since early in April and has proved a complete success, giving no trouble whatever and lighting the store at less than half the cost of gas. It is a capital specimen of an installation under specially trying conditions, and shows very well what a little ingenuity can accomplish in the face of particularly exasperating obstacles.

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Chronological History of Electricity, Galvanism, Magnetism and the Telegraph, from B. C. 2637 to A. D. 1888.—Part I.*

BY P. F. MOTTELAY.

The invention of the Leyden jar is claimed with equal pertinacity for Kleist, Musschenbroeck and Cunæus. While it is necessarily conceded that Von Kleist first published his discovery, it cannot be denied that his explanation of it is so obscure as, for the time, to have been of no practical use to the others. It is stated by Priestley, "Notwithstanding Mr. Kleist immediately communicated an account of this famous experiment (which indeed it is evident he has but imperfectly described) to Mr. Winckler, at Leipsick, Mr. Swiettiki, of Denmark, Mr. Kruger, of Halle, and to the professors of the Academy of Lignitz, as well as to Dr. Lieberkuhn, of Berlin, above mentioned, they all returned him word that the experiment did not succeed with them. Mr. Gralath, of Dantzik, was the first with whom it answered; but this was not till after several fruitless trials, and after receiving further instructions from the inventor. The Abbé Nollet had information of this discovery, and, in consequence of it says, in a letter to Mr. Samuel Wolfe, of the Society of Dantzik, dated March 9, 1746, that the experiment at Leyden was upon principles similar to that made with a phial half full of water, and a nail dipped in it; and that this discovery would have been called the Dantzik experiment if it had not happened to have got the name of that of Leyden."

In the thirty-eighth volume of the *Philosophical Transactions*, No. 432, page 297, is given an abstract of a letter (dated Utrecht, January 15, 1733, O. S.), from Petrus Van Musschenbroeck, M. D., F. R. S., to Dr. J. T. Desaguliers, concerning experiments made on the Indian Magnetick-sand, chiefly gathered along the sea-shore in Persia. After detailing his many observations, Van Musschenbroeck asks: "And, now, what can this *sand* be? Is it an

Continued from THE ELECTRICAL WORLD, July 18, 1891.

imperfect magnet, or Subtile Powder of it, which, when it is grown up into a greater lump, makes the vulgar Loadstones? So I conjectured at first; but when I found by experience that common Loadstones, exposed to the fire, according to some of the methods above-mention'd, did rather lose of their force than gain, I alter'd my opinion; and now confess that I have not yet penetrated into the knowledge of the nature of this matter," (Abridgments of the *Phil. Trans.*, chap. III., vol. VIII, page 737)

See Dalibard, "Histoire," p. 33; *Dantzik Memoirs*, vol. I. pp. 407, 409, 411; Priestley, 1777, "The Hist. and Pres. State of Electricity", pp. 82–84; Musschenbroeck's "Epitome elementorum, etc.," 1726, "Tentamina Experimentorum Naturalium" 1731, and his "Disertatio Physicæ experimentalis de Magnete," as well as his "Elementa Physiae" 1734, and the "Introductio ad Philosophiam Naturalem" 1762, the two last named works being greatly amplified editions of the "Epitome."

A. D. 1745. Watson (Doctor, afterward Sir William), M. D., F. R. S., an eminent English scientist, bears "the most distinguished name in this period of the history of electricity." His first letters, treating of this science, are addressed to the Royal Society between March 28 and Oct. 24, 1745, and, on the 6th of February and the 30th of October, 1746, he communicated other similar papers to the same society, which are likewise to be found in the *Philosophical Transactions*.

Dr. Watson, like most scientists at the time, made numerous experiments with the Leyden jar, and he was the first to observe the flash of light attending its discharge. He says: "When the phial is well electrified, and you apply your hand thereto, you see the fire flash from the outside of the glass wherever you touch it, and it crackles in your hand." It is to him that we owe the double coating of the jar, as well as the *plus* and *minus* of electricity.

He also shows conclusively that glass globes and tubes do not possess in themselves the electrical power, but only serve "as the first movers or determiners of that power," and he also proves that the electric fluid takes the shortest course, passing through the substance of the best medium of connection and not along its surface. This he demonstrated by discharging a phial through a wire covered with a mixture of wax and rosin.

In order to ascertain the velocity of the electric fluid from the Leyden phial and the distance at which it could be transmitted, Watson directed a series of experiments upon a very grand scale, with the assistance of Martin Folkes, President of the Royal Society, Lord Charles Cavendish, Dr. Bevis, Mr. Graham, Dr. Birch, Peter Daval and Messrs. Trembley, Ellicott, Robins and Short. On the 14th and 18th of July, 1747, they experimented upon a wire carrying the electricity from the Thames bank at Lambeth to the opposite bank at Westminster, across the Westminster Bridge, and, on the 24th of July, at the New River, Stoke Newington, they sent a shock through 800 feet of water and 2,000 feet of land, as well as through 2,800 feet of land and 8,000 feet of water. Other experiments followed on the 28th of July and the 5th of August, as well as on the 14th of August of the same year, proving the instantaneous transmission of the fluid; while a year later, August 5, 1748, additional observations were made, through 12,276 feet of wire, at Shooter's Hill, showing again that the time occupied in the passage of the electricity was "altogether inappreciable." Regarding these experiments, Prof. Musschenbroeck wrote to Dr. Watson, *Magnificentissimis tuis experimentis superasti conatus omnium.*

Watson's experiments were repeated, notably by Franklin, across the Schuylkill at Philadelphia, in 1748; by Deluc, across the Lake of Geneva, in 1749, and by Winckler, at Leipsic, in 1750. It is said that Lemonnier (A. D. 1746) produced shocks at Paris through 12,789 feet of wire and that Betancourt (A. D. 1795) discharegd electric jars through a distance of 26 miles.

To Dr. Watson is also due the first demonstration of the passage of electricity through a vacuum. Noad tells us that he caused the spark from his conductor to pass in the form of coruscations of a bright silver hue through an exhausted tube three feet in length, and he discharged a jar through a vacuum interval of 10 inches in the form of "a mass of very bright embodied fire." These demonstrations were repeated and varied by Smeaton, Canton and Wilson.

His experiments in firing gunpowder, hydrogen, etc., by the electric spark, are detailed by Priestley at page 78 of his "History, etc.," London, 1775.

Watson was rewarded with the Copley medal for his researches in electricity, which brought him also honorary degrees from two German universities. He was knighted in 1786, one year before his death.

See: "Watson's Experiments and Observations on Electricity," 1745, also his "Account of the Experiments made by some gentlemen of the Royal Society, etc.," 1748; *Phil. Trans.* for 1745, vol. XLIII., p. 481; for 1746, vol. XLIV., pp. 41, 704; for 1747, vol. XLIV., pp. 388, 695; for 1748, vol. XLV., pp. 49, 491, and vol. X., abridged, pp. 281, 286 296, 303, 305, 309–311, 357, 360, 363, 368-369, 394. See, likewise, *Scientific American Supplement*, No. 718, p. 11, 471 for an interesting engraving of Dr. Watson's experiment made through the water of the Thames, as well as for a detailed account of Lemonnier's experiment above referred to.

A. D. 1746.——Lemonnier (Pierre Claude Charles), a distingnished savant, who was member of the French Academy as adjunct geometrician before he had attained his 21st year and became foreign member of the English Royal Society three years later, was, according to *La Nature*, the first scientist who drew electricity from the narrow domain of the laboratory.

He confirmed the result previously obtained by Grey (A. D. 1720) that electric attraction is not proportioned to the mass or quantity of matter in bodies, but only to the extent of their surface, length having greater effect than breadth (*Phil. Trans.*, vol. XLIV., for 1746, page 290). He found that an anvil weighing 200 pounds gives but an inconsiderable spark, while the spark from a tin speaking trumpet 8 or 9 feet long, but weighing only 10 pounds, is almost equal to the shock of the Leyden phial. A solid ball of lead, 4 inches in diameter, gives a spark of the same force as that obtained from a thin piece of lead of like superficies bent in the form of a hoop. Finally, he took a thin and long piece of lead, and noticed that when it was electrified in its whole length it gave a very strong spark, but a very small one when it was rolled into a lump (*Ac. Par.*, 1746, M., p. 693). Le Roi and D'Arcy showed that a hollow sphere accepted the same charge when empty as when filled with mercury, which latter increased its weight sixty fold. All this proves the influence of *surface* as distinguished from that, *mass* (Tyndall, Notes on Lecture IV.)

Lemonnier discovered that electricity is ever present in the atmosphere, that it daily increases in quantity from sunrise till about three or four o'clock in the afternoon, diminishing till the fall of dew, when it once more increases for a while, and finally diminishes again before midnight, when it becomes insensible. He observed a continual diminution of electricity as the rain began to fall, and he noticed that when the connecting wire was covered with rain drops, only a few of the latter were electrified, and he found that the electrified and non-electrified drops generally succeeded each other alternately. This called to his mind "a singular phenomenon which happened some years before, to five peasants who were passing through a cornfield, near Frankfort upon the Oder, during a thunder storm: when the lightning killed the first, the third and the fifth of them, without injuring the second or the fourth." (*Phil. Trans.*, vol. XLVII., p. 551.)

See: Lemmonier, "Lois du Magnétisme," Paris, 1776–1778; *Phil. Trans.*, vol. XLIV., p. 247, vol. XLVIII., Part I., p. 203; *Mémoires de l'Acad. des Sciences*, 1752, p. 233; Bertholon. "Elec. du Corps Humain," 1786, vol. I., p. 12; Harris, "Fricț. Elec.," p. 239; *Sc. American Supplement*, No. 718, p. 11, 471. See also reports of the experiments of G. B. Gardini ("De inflexu, etc.," §§50, 51), Andrew Crosse and others at "Bibl. Britan. Sc. et Arts," 1814, vol. LVI., p. 524.

A. D. 1746.——Bevis (John), English astronomer and Secretary of the Royal Society, first suggested to Dr. Watson the external coating of the Leyden jar with tinfoil or sheet-lead, and was likewise the first to observe that the force of the charge increases as larger jars are employed, but not in proportion to the quantity of water they contain. As water only played the part of a conductor, he rightly thought that metal would do equally well if not better, and he therefore filled three jars with leaden shot instead of with water. When the metallic connection was made between the three a greatly increased force was perceptible. The discharge from two or three of the jars was not double or treble that from only one, but the discharge from three was greater than that from two and the discharge from two much greater than that from one. This showed that the seat of the electric force is the surface of the metal and the glass, and proves that the force of the charge is in proportion to the quantity of coated surface.

Thus to Dr. Bevis belongs the credit of having constructed the first electric battery, although the honor has been claimed by the friends of Daniel Gralath (A. D. 1747).

See: *Phil. Trans.*, abridged, vol. X., pp. 374, 377; Wilson, "Treatise," London, 1752, Prop. XVII., p. 107.

A. D. 1746. — Le Cat (M.), a physician of Rouen, observed, when suspending several pieces of leaf gold at his conductor, that they hung at different distances according to their sizes, the smallest pieces placing themselves nearest the conductor and the largest farthest from it.

See "Histoire de l'Electricité," pp. 84 and 85.

A. D. 1746——Maimbray (M.), of Edinburgh, electrified two myrtle trees, during the entire month of October, 1746, and found that they put forth small branches and blossoms sooner than other shrubs of the same kind which had not been electrified. This result was confirmed by the Abbé Nollet, who filled two garden pots of vegetating seeds and found that the pot which he had constantly electrified for fifteen consecutive days put forth earlier sprouts as well as more numerous and longer shoots than did the other.

Like experiments were at the same time carried on with equal success by Mr. Jallabert and Mr. Boze, as well as by the Abbé Menon, principal of the College of Bueil at Angers, France. The last named also found that electricity increases the insensible perspiration of animals. He chose several pairs of different kinds, cats, pigeons, chaffinches, etc., and weighed each separately. After they were electrified, one cat was 65 or 70 grains lighter than the other, the pigeon from 35 to 38 grains, and the chaffinch had lost 6 or 7 grains. He also electrified a young man or woman, between the ages of 20 and 30, for five hours and found a loss in weight of several ounces.

With reference to the effect of electricity on different varieties of growing plants, the Boston *Journal of Commerce* has recently published the following:

"In the last few years some very interesting experiments in gardening by electricity have been made by Prof. Selim Lemstrom, of the University of Helsingfors. These have been carried out both upon the potted plants in the hot house and upon plants in the open field, the insulated wires in the latter case being stretched upon poles over the plot of ground, and provided with a point for each square metre of area. The current has been supplied by Holtz machines run from eight to eighteen hours daily, the positive pole being connected with the network of wires and the negative with a zinc plate buried in the ground. The electric influence was scarcely perceptible in the growing plants, but was very marked in the yield of many species, especially of barley and wheat, of which the crop was increased by half in some cases. In the hot-house the maturity of strawberries was greatly advanced. The results have shown that plants may be divided into two groups: one, the development of which is favored by electricity, comprising wheat, rye, barley, oats, red and white beets, parsnips, potatoes, celeriac, beans, raspberries, strawberries and leeks; and the other, whose development is more or less interfered with by electricity, including peas, carrots, kohlrabi, rutabagas, turnips, white cabbages and tobacco. The more fertile the soil, and consequently the more vigorous the vegetation, the greater has been the excess of the crop under electric influence. Prof. Lemstrom's experiments up to 1887 were carried on in Finland, but he has since repeated his work in France, and demonstrated that the electric influence is the same in any climate, though likely to be injurious under a scorching sun."

See Nollet, "Recherches sur l'Electricité," pp. 306, 332; *Phil. Trans.*, abridged, vol. X., p. 384; *Electrical Review*, London, June 5, 1891, p. 707.

A. D. 1746.——Knight (Gowan or Gowin), F. R. S., an English physician, is the first to make very powerful steel magnets. The method, which he long succeeded in keeping secret, was described after his death, in the *Phil. Trans.* for 1746–1747, vol XLIV. It consists of placing two magnets in the same straight line, with their opposite poles close to or very near each other, and in laying under them the bar to be magnetized after having it tempered at a cherry-red heat. The magnets are then drawn apart in opposite directions along the bar, so that the south pole of one magnet can pass over the north polar half of the bar, and the north pole of the other magnet may pass over the south polar half of the bar.

This was the manner in which Dr. Knight made the bars of the two great magnets of the Royal Society. Each magnet contained 240 bars, 15 inches long, one inch wide and half an inch thick. Dr. Robison described, in 1800, the effect of pressing together the dissimilar poles of the two magnets, and, thirty years later, Prof. Faraday, upon placing a soft iron cylinder, one foot long and three quarters of an inch in diameter, across the dissimilar poles, found that he required a force of one hundred pounds to break down the attractive power.

Previously to Dr. Knight's discovery the method of making artificial magnets most in use was a very efficacious one, the bar to be magnetized being simply rubbed upon one of the poles of a natural magnet in a plane at right angles to the line joining its two poles.

Another secret of Dr. Knight was also, after his death, made known to the Royal Society by its secretary, Mr. Benjamin Wilson. It was the mode of making artificial paste magnets. He collected a large quantity of iron filings, which he cleansed and made into a fine powder under water, and which he afterward dried and mixed, preferably with linseed oil. This was baked into cakes, which he magnetized by placing them between the ends of his magazine of artificial magnets.

To Dr. Knight was given the first English patent in the Class of Electricity and Magnetism. It bears date June 10, 1766, No. 850, and is for the construction of "Compasses so as to prevent them being affected by the motion of the ship, etc."

See: *Phil. Trans.*, vol. XLIII., pp. 161, 361—vol. XLIV., p. 656—vol. LXVI., p. 591—vol. LXIX., p. 51; Noad "Manual," 1859, p. 593.

A. D. 1746.——Gravesande (William Jacob), celebrated Dutch mathematician and moral philosopher, whose family name was Storen Van 'Sgravesande, is the author of "Eléments de physique démontrés mathématiquement. . . . on introduction à la philosophie Newtonienne," which was translated from the Latin and published at Leyden in 1746.

At page 87 of the second volume of the last named work he gives a description of an electrical machine constructed on the plan of that of Hawksbee. It consisted merely of a crystal globe, which was mounted upon a copper stand, and against which was pressed the hand of the operator while it was made to revolve rapidly by means of a large wheel.

Gravesande taught publicly on the Continent the philosophy of Newton, and, by so doing, was one of the first to bring about a revolution in the domain of physical sciences generally. His original "Physica Elementa Mathematica," as well as his "Philosophiæ Newtonia, etc.," and "Introductio ad Philosophiam, etc.," were respectively published at Leyden in 1720, 1728 and 1736.

The Dubuque (Ia.) Storage Battery Street Railway.

BY FRED. DE LAND.

In the summer of 1778 a French Canadian named Julian Dubuque built a cabin at the base of one of the picturesque bluffs that line the west bank of the Mississippi, and at a point nearly opposite to what is now the termination of the state line dividing Illinois and Wisconsin. Other fur traders located about Dubuque's cabin. Following the extinguishment of the Indian title in 1833 a town was incorporated in 1837 and granted a city charter in 1840. In the past the river traffic and lead and zinc mining have added largely to the wealth of its citizens, and to-day it is a prosperous city of 35,000 inhabitants, supporting three electric street railway lines, a commodious telephone exchange, two electric lighting companies, and the Holly system of steam heating.

Of the street railway lines the one presenting the most novel features is the Dubuque Street Railway Company, which is employing storage battery cars for the transportation of its passengers, the company having nine new Brill cars, six of which are in daily operation, and the remaining three will be placed in service during the coming week.

Each of the nine cars has two 15 h. p. double reduction Edco motors, both motor and gearing being fully protected from mud and slush by an iron casing, as shown in the illustration presented herewith, while underneath the seats, which run lengthwise on each side of the car, are placed 80 secondary cells of the Accumulator Company's type "23 M," arranged in two trays holding 40 cells each.

During the period—since May 17—that these cars have been in daily service their operation has given excellent satisfaction to both the officials of the company and the local patrons, and the item of repairs—that bugaboo of street railway men—has not yet put in an appearance. Six additional cars have been ordered, but will not be in operation till the completion of five miles of new branch line.

The track exceeds 12 miles in length, has several sharp curves and three grades rising to five per cent. The old track was built of 52-lb. Johnson girder rails, bolted to white oak ties laid four feet apart, while the new section of track consists of 48-lb. Johnson girder rails, placed on sawed white oak ties, 6″ x 6″, placed but two feet apart and the whole well ballasted. An additional two miles of track is about completed, but not yet connected to the main line, and three miles additional is under way.

Of the present power-house but little can be said, but probably a new one will shortly be erected near the junction of the branch lines with the main road and an efficient engine of the Corliss type added. At present from two boilers of 100 h. p. each steam is supplied to an old compound condensing engine of local make that does not govern closely, and which is belted to a 50,000-watt Griscom standard generator of high efficiency, that is driven to charge each set of batteries at about 210 volts with 30 ampères to a cell.

The switchboard is the regulation affair of slate and wood, and arranged to support nine current regulators, nine ammeters reading from 0 to 40 ampères, one ammeter reading from 0 to 200 ampères and placed in the main circuit, and one voltmeter reading from 0 to 250 volts that may be connected by means of a switch in circuit across the terminals of the generator to show the E. M. F. of the generator when running, used as a balancing voltmeter in starting, or used in measuring the E. M. F. at the terminals of the individual batteries; and six knife switches, all being of the improved type, manufactured by the Electro-Dynamic Company, of Philadelphia, which built all the electrical apparatus save only the cells.

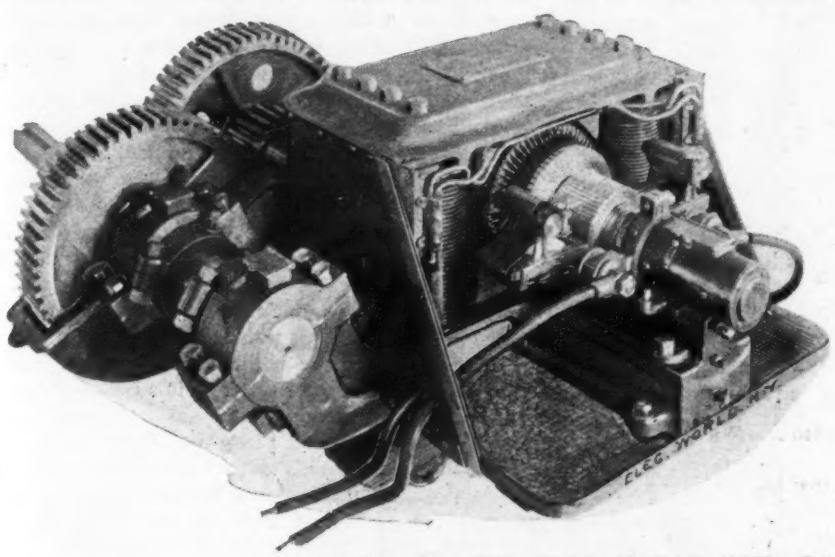
From the switchboards Okonite conductors pass to the automatic connections mounted on slate bases that are attached to a heavy oak plank supported at right angles above the trays, and as the trays are rolled into their respective positions on the charging table the battery terminals automatically connect in circuit and at once are ready for charging.

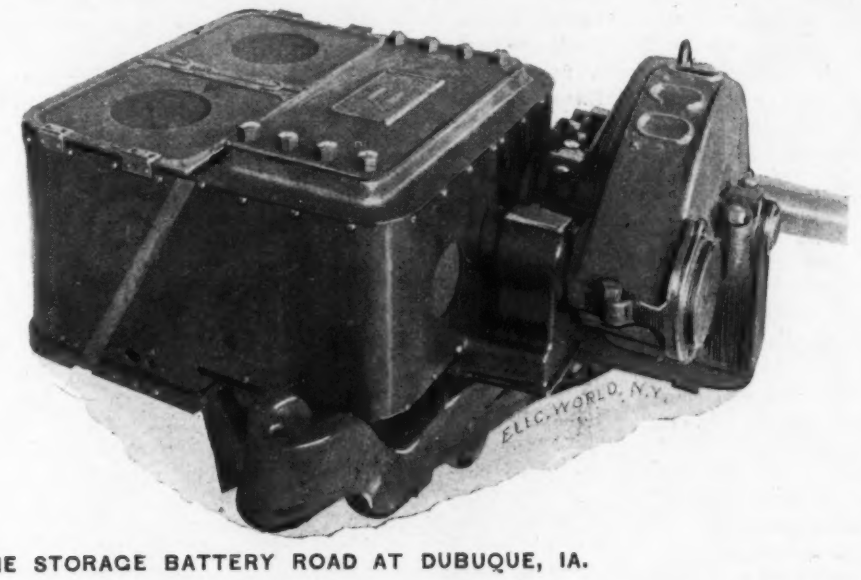
Each tray contains forty cells of the "23 M" type of accumulator, and rests on individual planks supported on a strong platform, each plank being trussed to keep the centre in alignment, and having a guard rail made of 1¼-inch angle iron extending its full length. Owing to the weight they sustain the trays are strongly constructed, the ends and side pieces being of sheet iron three-sixteenths inch in thickness and eight inches in height, bolted to a bottom plank two inches thick, on the under side of which casters are placed and an iron rack fitted in a longitudinal groove in the centre of the plank.

The platform or charging table is 12 feet wide by 40 feet long, and constructed to support twenty-four trays holding forty cells each, each weighing forty pounds, making the total weight of tray and cells about 1,700 pounds. Extending along the entire front of this table is a shaft to which is keyed a separate gear wheel for each of the 24 trays. When a tray of cells is required a cam, having a play of an inch, covers the tray so that the teeth of the gear wheel mesh into the rack on the bottom of the tray, and a few revolutions of the handle of the shaft quickly transfer the tray to the shifting table.

This shifting or transfer table is mounted on four car wheels running on tracks extending across the station; is 12 feet wide by 10 feet long, and across the solid top guard rails are placed to correspond with the rails on the charging table, the shifting table being arranged to accommodate six separate trays and having six independent gear wheels for use in transferring trays either from or to the table.

The batteries are changed in each car every three hours after the car has presumably traveled 25 miles. At the appointed hour the car enters the station while on its down trip, is run close to the shifting table, on which two trays of charged cells have been previously placed; the doors formed of one-half of the dashboard and those closing the battery receptacle underneath the car seats are quickly opened; a bridge having guard rails is placed on each side of the car platform close to the battery opening and connecting with the guard rail of transfer car, and with a few turns of two handles the old trays are transferred from the car to the shifting table; then the latter is moved a few inches and the charged cells quickly shot into position under the car seats, where the connections are automatically made, the doors closed, and the car continues on its trip after being detained less than three minutes.





FIGS. 1 AND 2.—THE EDCO MOTOR USED ON THE STORAGE BATTERY ROAD AT DUBUQUE, IA.

At first thought the time consumed in replacing the cells in each car once every three hours, or seven times a day, may appear to be a serious drawback to the adoption of the system. But, on the contrary, personal observation has shown that the average time consumed, from the moment the car leaves the main track till it again starts on its regular course, is little more than is lost in the changing of horses where horse-cars are used, and may be itemized as follows:

In reaching transfer table	25	seconds
" removing trays	70	"
" replacing trays	40	"
" reaching main track	20	"
Total	155	"

This time has been frequently reduced to 110 seconds, but a fair average is given above. Two laboring men do all the work, the motor-man remaining at his post awaiting the signal to depart. No conductors are employed, the passengers depositing their fare in a fare box. About 50 seconds are consumed in placing the trays taken from the car in position on the charging table and about 90 seconds to note the readings on the voltmeter showing the potential at the terminals of each individual cell. The method employed in operating the car is of the most simple character, and several of the men now acting as car operators claim to have never worked on a street car line until within the last six weeks.

On each platform of the car is placed an oval box 9 inches wide by 24 inches long, holding the battery switch and the motor switch. The usual hand brake is also placed close to this switch box. The face of the battery switch is marked with four points, and when starting the car the switch handle is turned to the first point cutting in the battery arranged in parallel of four groups of 20 cells each, giving an E. M. F. of 40 volts; moving the switch handle to the second point gives two sets in series and the two series in parallel of 40 cells each with an E. M. F. of 80 volts; at the third point the cells are thrown in series and half an ohm of resistance is introduced into the circuit merely to afford an intermediate speed, the switch handle remaining on the third point for only a second; at the fourth and last point the 80 cells are in series the resistance cut out, and the current of 160 volts pressure flows through the switch to the brushes of the motor through armature and fields, and returns to the battery. In stopping the car the movement of the switch handle is reversed and the battery gradually cut out. The average speed made is about 10 miles an hour, though that speed can be safely doubled on a clean track when the street is comparatively clear of vehicles. The cars are seldom if ever behind time at the starting point, for if delayed by a blockade the lost time is quickly made up by an increased speed. The two motors are connected to run singly or together, in parallel or in series, to be operated from either end of the car, and to be reversed either singly or together and in series, but not in parallel. Were it not for the poor condition of the macadamized roadways the second motor would not be required, as by the aid of a single motor 80 to 100 passengers have been carried on a motor car when the rails were clean and dry. The broken condition of the macadam on the roadway results in the rails being more or less covered with slippery mud during rainy weather, and wherever there is excessive sprinkling of the streets. However, the second motor insures the carrying of any load of passengers under any ordinary stress of circumstances and during the most unfavorable weather.

Each car has a simple and efficient device added that is termed the electric brake, the application of which insures the stopping of the car within half its length, even though running at full speed; but so powerful is its effect that it is only used in cases of extreme urgency, for the strain on pinions and armatures is necessarily severe unless the resistance placed in the circuit is cut out by a skillful hand. Brakes are not applied to the wheels; the operation consisting of simply shutting off the current from the batteries and then turning the motor switch handle to a point connecting the motor up as a dynamo that is being driven by the momentum of the car, the current generated being sent through four sets of resistance coils, each of which is represented by a point on the switch, and each of which is rapidly cut out till the motor, working as a dynamo, is on a short circuit, all movement being stopped by the heavy overload in far less time than it takes to explain it.

Each car is wired with an independent circuit connected to batteries that furnish the necessary illumination for the interior of the cars and for headlights.

Two independent circuits fitted with automatic plugs at the terminals lead from the switchboard in the station-house to near the main entrance, enabling the batteries in the last car that comes in after midnight to be charged without removing the trays from the car.

The work of charging the cells is supposed to commence at 9 A. M. and continue until 3 A. M., it being the rule that every battery shall be fully charged at night before the engine is stopped; thus there would always be a sufficient supply in the two sets of 40 cells each with which each car is provided to operate the cars for two periods of fully three hours each.

Regarding initial cost of the system it is difficult to particularize, as the old stables and car barn are used as a temporary power and station house, and as a suitable power-house is being planned, not a cent has been expended on any improvement connected with power or station house that could be termed a permanent one. A general idea of the first cost of equipping a road may be drawn from the report of the Executive Committee of the Street Railway Association, showing the comparative costs of different methods, the storage-battery system requiring as follows for an equipment of 15 cars and 10 miles of track:

Cost of roadbed	$70,000
Cost of cars	75,000
Cost of power plant	30,000
	$175,000

Of course the first and last items would not figure in an estimate for a road already equipped with power.

Regarding cost of operation, it may be said that although the present sale of nine cars completely equipped,

and which was followed by an order for six more complete cars, was based on the satisfactory operation of a single car during a 10 months' trial run, yet it is too early to give any statement in detail of the cost of operation on which comparative results could be based, as the six cars have been running less than two months and the storage batteries for the remaining three cars have not yet arrived. However, during this period of two months not a cent has been expended in repairs, which speaks well for the future; and would seem to indicate that the cost of operation will be limited practically to the production of the necessary steam to drive the generator, the renewal of the positive plates, and the labor incident to charging and placing the cells in service, together with the usual office force. Aside from the clerical force required in the office, operating the 15 cars from 6 A. M. till midnight or later will necessitate the employment of one superintendent, one chief electrician, one assistant electrician, two engineers, two firemen, four transfer men, 15 motor drivers, and the usual watchman, track cleaner, general repair man, etc. A less number than the eleven men first enumerated above could not do their portion of the work except by being overworked. But by having the trays moved by motive power the services of one transfer man could be dispensed with. It is the intention to use motor power in doing all work possible in the new station.

The citizens of Dubuque are highly pleased with the perfect working of the system, and are showing their appreciation in so substantial a manner that the daily income has more than doubled since the handsome Brill cars displaced the old wrecks that have been slowly hauled along the streets for a long period of time As the company's lines run through the best streets in the city, and as the operation of overhead electric systems has educated the people to a sense of the value of rapid transit, the company was compelled to adopt some new method that would prove more satisfactory than animal power.

Before adopting the storage battery system the president of the company, who is virtually the owner of the roads, visited the different manufacturers of secondary batteries, both in this country and in Europe, and personally inspected every storage battery car that he could learn was in operation, whether in New York, New Orleans or in Brussels. Thus he is posted on the merits and demerits of the different systems, and believes that successful operation —in every sense—is dependent primarily on the life of the positive plates, and on the ability of the company to keep the rails clean and free from snow and ice. The company is certainly entitled to a great deal of credit for introducing the system on a fair working scale, and where it can make its record side by side with the overhead trolley.

The fact that perfect and rapid transit service is afforded the citizens of Dubuque without the use of overhead circuits, of steam dummy, gas motor, cable conduit or animal power is awakening a widespread interest among street car and city officials in all sections of the country, and every mail brings requests for detailed information, while Manitoba on the north, Texas on the south and New England in the east have sent representatives to see in successful, practical operation a system that could only prove a blessing to any city in which it was introduced.

In conclusion, it may be stated that the officers are: President, J. A. Rhomberg; superintendent, J. H. Rhomberg; secretary and treasurer, B. E. Trinehan.

The gentlemen who are entitled to the credit of having placed in successful operation the first street railway line in this country that is completely equipped with storage-battery cars are Mr. M. Pfatischer, who placed the trial car in operation, and after remaining about two months in Dubuque left Mr. C. W. Regester in charge, who left the trial car in operation until the arrival of the six new cars, when he placed the latter in service. During the last two months Mr. Regester has been assisted by Mr. E. L. Price, who has had considerable experience in storage-battery traction. All these gentlemen are representatives of the Electro-Dynamic Company, of Philadelphia.

It is worthy of note that to Mr. Regester's perseverance in keeping the batteries charged under circumstances that would have disheartened many a man of less courage and conscientious scruples is the credit due for the excellent records made by both the trial car and the new ones just placed in operation; for the facilities placed at his disposal by the local company, especially in the matter of power, have been unnecessarily crude and inefficient in character—a literal application of the common saying that "storage-battery traction must fight its own way against all odds."

The Speed of Electricity.

The experiments now in progress at McGill College, Montreal, under the auspices of the British and Canadian Governments, to ascertain the longitude of Montreal by direct observations from Greenwich, have led to the accomplishment of a remarkable telegraphic feat. The English papers report it thus: "The first thing to determine was the length of time it took a telegraphic signal to cross the Atlantic. An automatic contrivance, whereby the land line could work into the cable, was provided, and a duplex circuit was arranged, so that the signal sent from Montreal would go over the land lines to Canso (Nova Scotia), thence over the cable to Waterville, Ireland, and return to Montreal again. Attached to the sending and receiving apparatus was a chronograph, which measured the time. Out of two hundred signals sent, it was found that the average time taken to cross the Atlantic and back again—a distance of 8,000 miles—occupied a trifle over one second, the exact time being one second and five-hundredths. Prof. McLeod, who is carrying on the experiments with Mr. Hosmer, the manager of the Canadian Pacific telegraphs, has left for Canso, where further experiments will be made. As soon as this work is completed, the Canadian Pacific Railway has offered its wires for determining the longitude and latitude of Vancouver, B. C."

A Point of Economy in the Working of Electric Light and Power Stations.

BY LEONARD PAGET, PH. D.

The work of the electric light and power engineer very well illustrates the result of continued application to a single line of ideas. The electrician has brought the dynamo machine to such a state of perfection as an expedient for converting mechanical power into electricity and electricity into mechanical power, as renders this machine a marvel of scientific development exceeding in its economical transformations the steam engine, and, in fact, every other mechanical power device. We all know that any good dynamo machine will transform into electricity within a very few per cent. of all of the mechanical power applied to its shaft, and it will convert into mechanical power with equal efficiency the electrical power given to its circuits. Undoubtedly we may, in the future, obtain a more economical transformation of electricity into light; but here, to our present views, the economy that can be effected is very small compared with the economy that can be obtained in the generating of mechanical power that we, by means of the dynamo, convert first into electricity and then into light. Great strides have been made in the economy of high-speed steam engines; but little attention has been paid by electricians to the waste of fuel occurring in the furnace under the boiler that supplies the steam actuating the steam engine from which the mechanical power is derived. And it is here that we propose to point out how economy can be effected by a careful study of the constitution of the furnace, the adoption of accessory devices, and proper firing.

Without wishing to find fault, we will suggest that the electrical engineer usually gives very little attention to the proper firing of his furnace. It is astonishing what waste a careless and unintelligent fireman will cause. It is not at all unusual, even in stations otherwise very carefully manipulated, to find that with expert firing an economy of as much as 15 to 18 per cent. in the amount of fuel used can be attained; especially when attention is also paid to the fuel employed with relation to the draft of air available to burn that fuel. It seems to be little understood that in order to create a draft of air sufficient to burn fuel economically with ordinary chimney draft quite a considerable quantity of fuel must be used solely for the purpose of creating this draft; that is, the chimney stack must be maintained at such a temperature as will create a sufficient current of air to consume the fuel, and this temperature can be maintained only by a consumption of a certain proportion of the fuel, which proportion amounts in many cases, and perhaps generally, to one-fourth of the whole of the fuel burned.

Here we may consider the advantage of an accessory device which will, with a smaller amount of fuel than 25 per cent. of the whole consumed, create the same draft. It has long been known to those experienced in the art of steam making, that a moderate blast is more economical than ordinary draft created by a chimney, and for this statement we have the best authorities. But the draft must be strictly moderate, and not applied by rule of thumb, but carefully considered as a method in relation to the furnace, the kind of boiler and the kind of coal. For if we employ too great a blast, we drag our heat through the furnace, through the boiler and into the stack, and lose it. Again, the blast must be under control and variable according to the amount of work required. To employ the same blast, as is very frequently done, whether the work be light or heavy, is as unbusiness-like as to provide a chimney stack and flue without a damper. The advantage of the blast, it is true, lies in independence of the weather and gives us capability at all times of being able to "force our boilers." But, on the other hand, if much of our work that is to be done includes for short times the full capacity of our boilers, and for long times the carrying on of light work with nearly "banked" fires, then the blast is at a disadvantage. Finally, we have to consider the kind of blast we would employ, whether it is created by steam jets, or by fans or blowers, or in other ways.

Probably the cheapest mode to create a blast is when we can use water-power to turn a fan. At other times it is economical to drive a fan from the main shaft of a building; or, again, the blast may be obtained by steam jets. In the application of steam jets, however, a somewhat serious complication arises which is not at first apparent to the electrical engineer on account of its chemical nature.

A large number of devices have been brought forward from time to time for the injection of steam, both below and above the fire; but only a certain amount of economy has attended their use. Investigation shows that this economy is due solely to the advantages that arise from the use of a moderate blast in connection with providing by the steam of an aqueous atmosphere or atmosphere saturated with aqueous vapor in the furnace and flues of the boiler, over that which is due to the generation of hydrogen gas by the decomposition of the steam by the red-hot fuel. It is well known that the conductivity for heat of an atmosphere saturated with aqueous vapor is very much greater than that of a dry gas, and for this reason, when steam is employed and the atmosphere of the furnace is thus charged with aqueous vapor, the heat from the fire is much better conducted from the grate to the boiler than when dry gases merely are caused to circulate in the furnace and boiler flues. It has been claimed that an injection of steam beneath the fire, because it causes hydrogen gas to be generated, affords a gaseous fuel that yields further heat by its combustion. Undoubtedly if steam be caused to impinge upon red-hot fuel of a carbonaceous or otherwise oxidizable nature, the oxygen of the steam will be taken up and the hydrogen set free; and this hydrogen can be burned if given sufficient air to do so. But the heat generated by the combustion of the hydrogen is largely discounted by the heat absorbed and rendered latent when the hydrogen is set free, on account of the enormously high capacity of this gas as referred to other gases and vapors, for heat; and if any of this gas escapes to the chimney stack, as, owing to its large volume, it is very likely to do, the amount of heat lost is serious. Some such cause as this must underlie the want of economy that upon careful testing is always shown in the use of the steam jet when it is employed with a view of obtaining a gaseous fuel, and for any other purpose than to give a moderate blast and produce a saturated aqueous vapor in the furnace and the flues.

Where we introduce the air into our furnace is another important consideration affecting the economy with which we can burn our fuel. The thoughtless engineer assumes that all the air should pass through the fuel, and he instructs his firemen to that end to constantly rake and break up the fire, and he maintains a thick bed of fuel on the grate bars. This is one of the courses most fatal to good economy, because, as insufficient air to burn the fuel will pass through the thick layer of fuel, the coal becomes distilled into gas or incompletely consumed into carbonic oxide, and there being insufficient air above the fuel to burn these gases, they pass away into the stack and are lost as useful combustibles. In view of these facts several devices have been put forward for the introduction of air into various parts of the furnace.

In one of these devices for effecting complete combustion a double furnace has been provided alternately fired, the gas distilled from fresh fuel in the one of the pair of furnaces being burned by the excess of air which passes through the red coke on the grate of the other furnace. In another device, air is admitted above the fuel to burn the gases evolved and below it to burn the coke. Again, in another air is admitted through perforations in a double door and double front to the furnace. Self-acting apparatus has also been devised having an air inlet constructed like a Venetian blind, which is opened when fresh coal is supplied, and which gradually closes as the gas of the fresh fuel becomes exhausted, in such a manner as to supply the air when it is most wanted. Fans have been used to blow air through two sets of nozzles, one opening into the closed ash pit and the other into the furnace immediately above the fuel. Steam jets have also been employed to blow in air through holes immediately above the fuel. Means have, too, been provided to close the ash pit when fresh fuel is added, then admitting air above the fuel to burn the gases, and subsequently shutting off this upper supply and opening the ash pit to admit air beneath the fuel to burn the coke that has been formed. In one case it has been tried to supply the air wholly by jets directed downward on the fuel from above. But the economy of fuel really depends on the proper rate of combustion per square foot of grate to the draft of the furnace, and this fixes the best area of grate to employ for a particular boiler. For if the grate is too small the combustion becomes imperfect, and if too large more air is admitted than is needed and heat is wasted in warming it. The best plan, therefore, is to build the grate too large, and reduce its area by fire-bricks until the smallest area is obtained that will give perfect combustion of the amount of coal required to be consumed. If already the grate is too small and it cannot be enlarged, then we must try to introduce air above the fuel, because when air is admitted above the fuel to burn the gas from the coal, a lesser grate area is required to burn a given quantity of fuel in the same time than when the whole air supply has to pass through the grate from beneath.

The production of aqueous vapor in the furnace and the flues as affording economy is recognized by the advocates of wet fuel, who claim that certain classes of fuel should be fired wetted with water, to produce an economy. Whether the economy is real or not, even given favorable conditions, has never been fully tested.

But the greatest economy in the fuel, given a construction of furnace best adapted to it, is undoubtedly to be obtained by judicious firing. Unfortunately, judicious firing is almost wholly dependent on the honesty of the fireman, because it entails upon him both judgment and extra work. Even if we overcome the difficulty due to judgment being required in the class of men usually employed as firemen, by careful instructions and by rigorou

enforcement of these instructions, we have still the deterrent fact before us that careful firing requires extra labor. Careful firing means that the thinnest possible layer of coal should be maintained on the grate bars consistent with perfect combustion of the required quantity of fuel, and this needs more frequent firing than is the rule. A fireman, however honest he may be, knows that if he maintains a thick layer of fire he will have to coal less frequently than with a thin layer; and he believes, as do many employers, that he obtains more heat from a thick layer than he does from a thin, which is probably true within certain limits, but not at all true within the limits usually kept. A good fire two inches thick practically radiates as much heat as does a fire four inches thick. Less gases are formed and more air is admitted to burn them to perfect combustion than with the four-inch fire. Therefore, better combustion is maintained with a thinner fire; but the fireman has twice as much work to do, because he has not only to throw in his coal on the thinner fire more frequently, but he has to distribute it much more carefully than with the thicker fire, and he cannot smooth the thinner fire down to give it the appearance of good firing that he can get with a thicker fire. Let our central station superintendents try this. Let them insist on a thin fire with a moderate draft, using good fuel, and they will speedily learn from a comparison of their coal bills that they are in possession of means of great economy.

A Portable Electric Lighting Plant.

We illustrate on this page a portable electric light plant constructed by Messrs. Hayward Tyler & Co., of Whitecross street, London, for a large dock company. We are indebted to *Engineering* for the illustration. The plant is mounted upon a frame carried by four wrought-iron travelling wheels, and is fitted with a pole for a double team. The boiler stands in the centre, the engine being at one end and the dynamo at the other. The boiler is six feet six inches high by two feet nine inches in diameter; the firebox is crossed by two tubes eight inches in diameter. The engine has a cylinder five inches in diameter by six inches stroke, and is of the inverted type, with Pickering governor. By means of a belt it drives the dynamo. This is compound wound to give 20 ampères of current at a pressure of 10 volts when running at 650 revolutions per minute. It supplies incandescent lamps of 200 c. p. each. Each lamp is provided with a strong enameled iron reflector fitted with a wire guard, and a length of twin flexible cable. A plant of this description will be very useful in many kinds of outdoor work.

AN ENGLISH PORTABLE ELECTRIC LIGHTING PLANT.

Telephone Service in Boston.

The new building of the American Bell Telephone Company, which is rapidly approaching completion and is now partly occupied, stands at the corner of Milk and Oliver streets, Boston. It is nine stories high, with an additional story of smaller dimensions. Of the nine stories the lower five will be rented for business purposes. Upon the sixth floor are general offices of the American Bell Telephone Company, as well as the treasurer's office and the offices of the legal department. On the next floor are the offices of the electrical and patent departments, with the company's archives, and the offices of the auditing and statistical departments. The eighth floor is given up to the business office of the New England Telephone and Telegraph Company, while the ninth story and the smaller one above it are entirely occupied by the operating departments of this company. The operating-room, as well as the distributing-room, cable shaft, underground ways, etc., are provided for an ultimate capacity of 6,000 subscribers' lines, and 1,500 trunk, ex-territorial and express lines. All lines enter the building through underground passages.

The subscribers' switchboard at present in use is 127 feet in length and requires the attention of 58 operators at one time. Each operator attends to 80 lines. In addition to the subscribers' board there are switchboards in which the long distance lines terminate, including lines to New York, Buffalo, Washington, Philadelphia, and all the important cities in New England. Some 18 additional operators are required to care for this service. The express system is carried on by means of another switchboard with 10 operators. The entire service requires the employment of about 90 operators in addition to the night force.

To transfer the service of the New England Telephone and Telegraph Company from the old office to the new one required 502 miles of wire made up in cable, and temporarily connected between the old and the new offices. The transfer to the new offices at the opening of the service from the new switchboard took place on Saturday afternoon, July 11, at three o'clock. The change was accomplished with but slight interruption of the service, considering the number of wires removed (between 5,000 and 6,000) and the fact that it requires some days of actual experience in the manipulation of the new apparatus before it can be considered to be in perfect working order.

Cost of Electric Traction.

The following statistics concerning the comparative cost of operation of the West End Street Railway as respects horses and electricity in the months of April and May have been obtained officially by the Boston *News Bureau*, and are believed to be the first authentic statements made public in detail as to the comparative cost of horse and electric lines in operation on a large scale.

	Total.	Electric.	Horse
APRIL STATEMENT.			
Gross receipts	$478,717	$134,321	$344,396
General expenses	30,707	8,193	22,514
Track and car expenses	184,141	47,447	136,693
Motive power	147,933	30,194	117,740
Total operating expenses	362,781	85,834	276,947
Net earnings	115,935	48,487	67,449
Miles run	1,478,346	394,459	1,083,887
Ratio of mileage	100	26.68	73 32
Per cent. operating expenses	76.82	63.36	80.62
Earnings per mile run	32.39	35.05	31.77
Expenses per mile run:			
Motive power	10.01	07.65	10.86
Car repairs	01.05	01.39	00.93
Damages	00.77	00 75	00.78
Conductors and drivers	08.03	07.33	08.28
Other expenses	04.68	04.63	04.70
Total expenses per mile run	24.54	21.75	25.55
Net earned per mile run	07.85	12.30	06.22
MAY STATEMENT.			
Gross receipts	$519,244	$144,638	$374,605
General expenses	30,478	7.796	22,682
Track and car expenses	173,344	45,413	127,902
Motive power	149,896	30,924	118,972
Total operating expenses	353,720	84,103	269,556
Net earnings	165,524	60,475	105,049
Miles run	1,471,004	376,321	1,094,683
Ratio mileage	100	25-58	74.42
Per cent. operating expenses	68.12	58.18	71.95
Earnings per mile run	35.29	38.43	34.22
Expenses per mile run:			
Motive power	10.19	08.22	10.86
Car repairs	00.79	01.33	00.60
Damages	00.50	00.89	00.37
Conductors and drivers	08.01	07.36	08.24
Other expenses	04.55	04.56	04.55
Total expenses per mile run	24.04	22.36	24.62
Net earned per mile run	11.25	16.07	09.60

The West End is as yet imperfectly equipped electrically, buying its power where it has not had time to complete its own plant, and has labored under the many organization disadvantages arising from so great a change as from horse to electricity, and President Whitney has therefore only very reluctantly consented to give these figures for publication.

The long electric cars make even a better showing than the above. They are operated by the same-sized Thomson-Houston motors as the smaller cars, and by reason of increased capacity earn considerable more per mile. The company is operating 75 of these cars now, has 75 more in the shops awaiting adjustment of trucks, and will eventually have many more in operation. These long cars earned $83,000, or 44 cents per mile operated, in May, and 46.9 cents per mile operated in the first half of June, the latest obtainable figures.

When the West End has finished its own power-houses it is calculated that it can reduce expenses of operating its electric cars to at least 20 cents per car mile, and with the long cars earning above 40 cents per car mile it can considerably extend the long-car service and still operate them upon a basis of 50 per cent. for expenses. The Tremont street line is the next to be equipped with the Thomson-Houston electric system. The West End service covers about 18,000,000 car miles run per annum, and it is not difficult, from this fact and the data above given, to figure that the change from horse to electricity is more than worth the expenditure upon capital account.

The net earnings of the West End gained over the previous year $15,000 in May, and though the figures are not yet made up, it will probably show a gain of $30,000 net for June. The net earnings of June and July should be about $200,000 for each month.

As showing the practical economy of electricity the West End Railway earnings for May have been figured on the basis of mileage being reversed, viz.: 1,094,683 miles run by electricity and 376,321 by horse, instead of the reverse, as was actually the case. Calculating that the electric cars would earn as much per mile on the greater mileage and that they could be operated as cheaply, the following result is obtained:

	Future, estimated.	Present, actual.
Gross earnings	$549,465	$519,244
Expenses	337,421	353,720
Net	212,044	165,524

The Dielectric Properties of Mica at High Temperatures.

In a paper recently read before the Académie des Sciences, M. E. Bouty described some investigations carried out by him with regard to the dielectric properties of mica at high temperatures. The result of M. Bouty's researches is to demonstrate the almost complete invariability of the dielectric constant of mica, which, between 0 and 300 degrees C., certainly does not alter by one-fiftieth of its original value. Above 300 degrees C. experimental complications occur, and tend to obscure the result. M. Bouty made use of silvered sheets of mica, and when the temperature was carried beyond 300 degrees C., the silver was attacked if in contact with the air, and the mica was soon covered by a transparent electrolytic film. This defect may be minimized by covering the silver with a fairly thick layer of copper. Above 300 degrees C. the charge furnished by the battery is no longer entirely recoverable, which is doubtless due to the formation of the conducting film, since the conductivity at the same temperature rapidly increases if the application of the heat is prolonged, and the conductivity is maintained on cooling until the superficial hygrometric layer has been washed away in alcohol. It is possible that between 300 degrees and 400 degrees C. mica may possess some slight specific conductivity. However that may be, says M. Bouty, the resultant conductivity between 300 degrees and 400 degrees C. is negligible for charges of brief duration.

These results will be of interest to all users of electrical apparatus, in the construction of which mica is used in greater or less quantities. The importance of the results will be understood when it is remembered that every dynamo and motor, as well as a great deal of the electrical measuring apparatus, in commercial use to-day has some parts insulated with mica.

Besides these extended uses the material finds a wide application in the manufacture of insulators for street-railway and electric-light line work and in many types of electrical switches.

Opinions on the Edison Decision.

As was the case two years ago when Judge Bradley delivered his now famous opinion in the law suit between the Sawyer-Man and Edison companies, THE ELECTRICAL WORLD came to the front last week with the full text of Judge Wallace's opinion, by publishing it not only prior to any other electrical journal, but ahead even of the daily papers. In looking after the interests of its readers it often is necessary to make special efforts in furnishing prompt news, and in this, as heretofore, THE ELECTRICAL WORLD was not found behindhand.

Some opinions of the decision from gentlemen intimately connected with incandescent lighting work, both in the city and elsewhere, are subjoined.

Mr. Samuel Insull, second vice-president or the Edison General Electric Company, said that the decision was a thoroughly satisfactory one to the Edison people; it gave them formally the rights for which they were contesting, and they had every reason to feel pleased at the result. As regards the exact policy to be pursued he was not prepared to make any definite statement.

Gen. S. A. Duncan, leading counsel of the United States Electric Lighting Company in the case, said that the decision was somewhat of a surprise both in its sweeping character and the unexpected way in which important evidence was passed over with hardly a word of comment. It was a decision rather on the general claims than on the strict interpretation of the evidence. The case would of course be appealed and carried at once to the Circuit Court of Appeals, and possibly, if necessary, to the Supreme Court, although this latter would be by no means certain. Meanwhile any attempt to obtain an immediate injunction would be vigorously fought. In coming before the Circuit Court of Appeals the case would not fall under the jurisdiction of Judge Wallace, although he is a member of the court, as thereby he would be reviewing his own decision. Judge Lacombe would quite certainly sit upon the case. The other two judges were as yet uncertain. It was Judge Lacombe who in a previous stage of the suit admitted the important evidence of the interpretation placed by Mr. Edison on the famous second claim of which so much was made at present, and it is therefore to be presumed that he would not be inclined to pass it by quite as slightingly as Judge Wallace has done. The decision was a disagreeable surprise, but the United States Electric Lighting Company was not thoroughly beaten yet.

Mr. J. H. Rhotehamel, president of the Columbia Incandescent Lamp Company, of St. Louis, Mo., who was in town to attend the meeting of the incandescent lamp manufacturers, said that although from his position he could not make any authoritative statements, he believed that the association, which comprises a dozen of the well-known manufacturers of incandescent lamps, would continue to manufacture until there was a sufficient cause for stopping. Of course the decision was regarded as highly unfavorable, and was of a somewhat unexpected character. His company and others had no difficulty in competing with the Edison lamp, although they charged a somewhat higher price, and he felt that it would be suicidally bad policy for the Edison company to take any high-handed measures to suppress the manufacture of incandescent lamps other than its own.

The enterprise shown by THE ELECTRICAL WORLD in publishing in full the opinion of Judge Wallace in the Edison lamp suit, was very favorably commented on by the leading members of the electrical fraternity in Chicago, all of whom are more or less interested in the subject.

Mr. F. C. Terry, manager of the Electrical Supply Company, in general conversation said:

"The decision in the matter of the incandescent lamp suit does not particularly interest me. We have sold incandescent lamps, as have all other dealers in our line, but it is quite immaterial to us what lamp we sell so long as it is the best we can obtain.

"I presume the effect of the decision will be to advance prices, which may in the end benefit all, as competition has reduced the selling prices of lamps now to such an extent that the profit, to dealers at least, is very small, and I understand that the manufacturers are now getting a smaller margin than formerly.

"If the Edison company can collect a royalty on incandescent lamps, it will of course be a big thing. At five cents a lamp it would amount to more than half a million dollars a year.

"The Edison company might be able to prevent others from making lamps, and in that way have a monopoly, but this would be only after a very expensive fight, as the interest against it would be united and very powerful, and this would probably prove less profitable, as the patent, I understand, expires in about two years.

"Then, too, I presume that such a course of suppression would stimulate invention, and a new lamp which would not infringe the Edison patents would be brought out. It is hard to believe that such a thing is not possible. In fact I know of experiments that have been carried on for some time in that direction, and, if my information is correct, the results are promising, if not an assured success."

Mr. C. A. Brown, of the new law firm of Barton & Brown, and who for many years was the manager of the Western Electric Company, said:

"The decision of Judge Wallace on the Edison lamp patent will gratify the owners of patents and it increases the value of patents for pioneer inventions by the disposition manifested by the court to construe the language of the patent liberally in favor of the inventor.

"The decision would have been less of a surprise if it had sustained the patent as to lamps of high specific resistance and had left the 50-volt lamp, for instance, outside its scope. It seems, however, to have sustained the second claim of the patent in all its breadth.

"The second claim is:

"The combination of carbon filaments with a receiver made entirely of glass, and conductors passing through the glass, and from which receiver the air is exhausted for the purpose set forth.

"Naturally the first thought of inventors will be to find some means of evading this claim, and there will be forthwith many patents applied for to cover inventions of lamps from the receivers of which the air is not exhausted, or in which the incandescent conductor is not a carbon filament, or in which the receiver is not entirely of glass, or in which the conductors do not pass through the glass. It is not an easy matter to inspire the consumer with confidence in such a lamp, however, even if one be found lacking any one of the essential elements of the combination covered by the Edison patent as construed by the court.

"The decision of Judge Wallace, therefore, goes a long way toward giving the Edison company a monopoly of the incandescent lamp business, and if this decision be affirmed by the Circuit Court of Appeals it is unlikely that anything can be looked for to break the control which the Edison company will thereby secure of the incandescent lighting business of the country during the life of this patent.

"This decision adds interest to the recent experiments of Tesla, and it may be that in that way lies the hope of the competitor of the Edison company.

"It goes without saying that the large interests which are at stake will not be surrendered without a struggle. Research and invention in this direction will be stimulated to a degree never before equaled, and therefore one effect of the decision which may be confidently predicted will be still further progress in electric lighting and the probability that this country will still keep in advance of all others in this important industry."

Mr. J. H. Cooke, manager of the Sunbeam Incandescent Lamp Company, was inclined to be conservative in his statements owing to his official position in the association, but his remarks may be summed up as follows:

"(1) The case will undoubtedly be appealed.

"(2) During the past five years hundreds of thousands of dollars have been invested in the manufacture of incandescent lamps by the companies now doing business. The 'Edison' case has been kept in mind; also the possibility of that company being successful in its suit for infringement.

"(3) It is reasonable to suppose that 'emergencies' would be prepared for; that they have been will be clearly demonstrated should a 'war of extermination' be determined upon.

"(4) What the policy of the Edison people will be in the event of final success may not be definitely settled in their own minds. The immense business interests of that corporation have been cared for in a manner suggestive of high executive ability and excellent judgment. So it would seem, considering the short life of the patent, that an advantageous arrangement for themselves and competing companies now doing business would be entered into which would result in stability of prices, at an increase of possibly 25 per cent. on present ones, and the production, too, of a better grade of lamps."

Mr. Francis W. Parker, the well-known patent attorney, was found in his offices, in the Opera-house Building, in Chicago, and, in referring to the decision, said:

"The first publication of the opinion in the lamp case which I saw was contained in THE ELECTRICAL WORLD, and I want to say that the prompt publication by the WORLD of this opinion showed enterprise and appreciation of the public want, such as to entitle the paper to the highest commendation of those interested in electrical industries. As to the opinion, I have little to say. I have followed this litigation with some interest, but find it almost as difficult to determine the exact meaning of the opinion as counsel seem to have found it difficult to understand the meaning of the patent. It seems, however, that it was the disposition of the Judge to sustain the patent by construing it narrowly. The limitations which are put upon the first claim seem to me to restrict it more than the case really required. As construed by the Judge, *it is certainly easily avoided by expert manufacturers.*

"The second claim the Judge, in like manner, covers with limitations, and particularly appears to limit the same to a construction in which platinum leading-in wires are used. There are certain lamps now in use which avoid the second claim as it appears to have been construed.

"These are only the first impressions. I do not know how much they may be modified by more extended consideration of the opinion. I do not, however, think that the construction put upon this patent in Judge Wallace's decision will be sufficient to secure for the Edison company a *monoply of the incandescent lamp.*"

Attorney E. C. Ferguson, a well-known counselor at law and member of the Chicago Electric Club, appeared surprised over the decision, and in explanation said:

"The court's finding was a surprise, and is in more ways than one a patent-decision, having all the patentable elements except merit. If an inventor is, by a vague description of his novelty, to be allowed by presumption and inference all he subsequently claims or discovers there will be no end of the production of cheap testimony to prove that subsequent discoveries were a part of the original conception of the intended effect to be produced. It will also annihilate all patentable improvements.

"The Court tacitly admits that the Lane-Fox patents embodied nearly the same principle that Edison claims to have discovered, only that they had not carried their experiments sufficiently far to produce a commercial device. Edison was in the same predicament, and had to invent subsequent improvements, for which he obtained patents, before he obtained complete incandescence in lighting. It therefore appears ridiculous to allow his subsequent inventions to relate back to his original patent. The same principle should apply to those contesting his patents.

"From a legal standpoint, if presumptions and assumptions in which the Court has indulged, and upon which this decision is based, were to be exercised in adjudicating right in other matters, the Court could say that, whatever the facts were at the inception, if the litigant stated that his subsequent acts and discoveries were intended to be included in his earliest statements (if time and acts have developed what he claims), then, by intendment, the latter must be included in the former, regardless of the date of discovery. The Court seems to have credited Edison with being all-wise, and the decision appears to be influenced by the high standing Mr. Edison has in his profession.

"The Court says: 'When a sufficient knowledge of the prior state of an art to which it relates has been acquired, and which presumably the inventor proceeds to incorporate, are reasonably apparent; . . . it may be that in Mr. Edison's haste to obtain improvements, real or imaginary, which he has *made* or *hoped* to *make*, he had not stopped to reflect when he framed his application; . . . it certainly would not involve invention to omit the coiling, and to omit to elongate the globe. . . . The language is satisfied if the burner is filamentary. . . . It is to be implied from the suggestions in the specifications, that it is to have sufficiently high total resistance for efficient use when the lamps are arranged in multiple arc. . . . It is of little import what Mr. Edison may have thought about the meaning of the claim during pendancy of the application for a subsequent patent. It appears the inventor builded wiser than he knew. . . .'

"An invention is a complete discovery. The Court admits in his decision that Edison did not know what he had discovered—'he had not stopped to think, nor does it matter, if he did not know what his claims covered'; that the radical change in the appliance when discovered relates back, because it does not take inventive genius to make improvements. It is implied he intended it so.

"Why did Mr. Edison take out further patents if his original patent covered everything? Because he subsequently conceived the patentable idea, and it is from that time that he can claim his priority. The doctrine laid down is dangerous, and will result ruinously to patents and manufacturing industries.

"The Court well said, 'Edison builded wiser than he knew.' He evidently had not counted on the court's ingenuity in a time of emergency. That statement would make an epitaph for many a poor inventor. The marked disregard of the defendant's evidence in the Court's opinion makes the criticism more just. I recognize the eminent standing of Judge Wallace, but I think he has made a mistake in this decision. I certainly think the United States Supreme Court will reverse this decision."

A New Way of Making Chlorate of Potash and Tin by Electrolysis.

The idea of this electrolytic process, which is due to M. Jobard, of Vincennes, is, says the *Electrical Review* (London), to manufacture chlorate of potash, and at the same time to prepare a by-product of sufficient value to pay the whole cost of working. It can be applied to the preparation of various substances; but here is an example of its use in which chlorate of potash and tin are proposed.

Stannic chloride is taken and dissolved into a neutral solution which must be concentrated; then a sufficient quantity of common salt (sodium chloride) is added.

The electrolysis is performed in a cemented vat. The elcetrodes are as follows: Anodes of graphite and cathodes of tinned iron. On causing the current to pass, metallic tin is deposited in a crystalline condition and chlorine is set free, the latter is passed into an ordinary chlorate of potash apparatus when it is used up. It is found convenient to heat the bath in order to facilitate the electrolytic action.

In working under the most favorable conditions possible, the loss of metal does not exceed 10 per cent. of the weight of the metal contained in the chloride, while the yield of chloride of potash is about 25 per cent. lower than that which corresponds to the theoretical weight of the chlorine liberated during the electrolysis.

The process can be applied to other metallic salts; thus, if the chlorides of zinc, copper, etc., be employed, the metals can be economically precipitated.

A Carbon Filament in a Transparent Vacuum Chamber, used by Despretz in his Experiments on the Fusibility of Carbon by Electric Heat.*

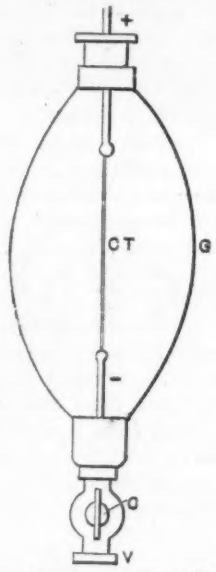
BY A. M. TANNER.

The object of this article is to prove that Mr. Edison was not the first to "invent" the term carbon filament, and that he was not the first to pass a high-tension electric current through a carbon filament inclosed in a transparent vacuous chamber. I notice that in the great suit now pending in the United States, involving the validity and scope of Edison's principal patent for his incandescent electric lamp, an eminent lawyer for the defense says, "The question was, When did Mr. Edison invent the lamp which depends for its virtue upon that particular form of carbon to which he has given the undefined and undefinable name of filament?"

The writer does not pretend that he is presenting anything new when he calls attention to the fact that Despretz fused and volatilized carbon by electric heat some 40 years ago. Many textbooks on chemistry and physics make reference to his experiments in this direction.

It is somewhat strange that in the many court suits concerning the validity of the Edison patent in England, Germany and the United States, no one has called attention to the fact that Despretz used attenuated or very thin carbon, and that he himself gives the term "carbon thread" or "very fine carbon threads" to some of the carbon used in his experiments.

In the *Comptes Rendus* of the French Academy of Sciences for the year 1849, page 709, the Despretz experiments on the fusion and volatilization of carbon are described in full. In one place he states that a "fil de charbon" is attached to the conducting wires of an electric egg.



CARBON FILAMENT OF HIGH RESISTANCE.

C—Cock; CT—Carbon thread; G—Glass tube; V—Vacuum pump connection.

This arrangement can be shown by the accompanying sketch.

In another instance he says that experiments with "fils fin" of carbon were made in a chamber containing nitrogen at a pressure of two or three atmospheres. It appears that Ruhmkorff made the carbon threads, and that the preparation thereof was a very delicate task.

In another part of the article Despretz says that he "curved and volatilized very fine carbon threads" ("fils très fins de charbon") by a Faraday battery of 60 elements arranged in series. It is also stated that carbon threads were fused and volatilized by the heat furnished by a Bunsen battery of 496 elements, arranged in four parallel series of 124 elements. By reference to any standard French-English dictionary, that of Clifton and Grimaux, for example, it will be seen that the English translation of the French word "fil" is given as "thread or filament." There can be no doubt, therefore, that Mr. Edison was not the first to render a carbon filament incandescent in a vacuous chamber by means of an electric current of a high electromotive force, because from the very nature of things incandescence and luminosity preceded the fusion and volatilization of the carbon.

The writer does not contend that the Despretz experiments anticipate the modern incandescent electric lamp. They are to be considered somewhat like the Crookes radiometer, which figures extensively in the American suits as possessing all but one of the elements of the combination making up the Edison lamp. Despretz, from the very condition of things, did not have the all-glass vacuum chamber and the leading in conductors sealed in the same. Despretz, however, did use a carbon filament or thread attached to leading-in conductors and inclosed in a transparent vacuum bulb or a chamber filled with an inert gas.

If Despretz and Ruhmkorff were still living they would be surprised to learn that so much time, oratory and printer's ink have been wasted in attempting to explain the nature of a carbon filament, a term long before used by Despretz, and that a kind of monopoly had been set up to the use of the words "carbon *filament*."

Despretz certainly used carbon of great resistance and slight surface, and the expression "very fine carbon threads" cannot mean anything else than "a high-resistance carbon filament," which required a battery of a very high electromotive force to send the current through the same.

*From the *Electrical Review*, London.

On a Modified Form of Wheatstone's Bridge.*

BY R. A. LEHFELDT, B. A., B. SC.

In comparing the resistances of two nearly equal coils, a fine adjustment may be obtained either by a divided wire of low resistance in series with the coils or by a resistance box in parallel with them. The latter method, involving only a piece of apparatus that exists in every laboratory, appears to be somewhat simpler than the more common

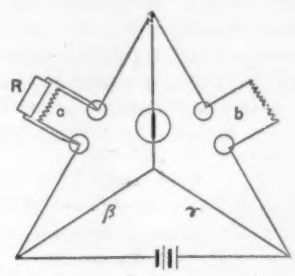


FIG. 1.—A MODIFIED FORM OF WHEATSTONE'S BRIDGE.

one, for which a specially mounted wire is required; and it avoids, moreover, the disadvantage of a sliding contact. It may therefore be worth while to give some details of its use.

In Wheatstone's bridge, let β and γ (Fig. 1) be nearly equal resistances permanently mounted. Let b and c be the coils to be compared, R a resistance box in parallel with the higher of the two. Let b_1, c_1 be the resistances of the connections of b and c. Put

$$\frac{cR}{c+R} = c';$$

then

$$(c' + c_1)\,\gamma = (b + b_1)\,\beta.$$

If c and R be interchanged with b and R has to be altered to R' for balance, putting

$$\frac{cR'}{c+R'} = c'',$$

then

$$(c'' + b_1)\,\beta = (b + c_1)\,\gamma.$$

Hence

$$b = \frac{1}{2}\left(\frac{c'\gamma}{\beta} + \frac{c''\beta}{\gamma}\right) + \frac{(b_1\beta - c_1\gamma)\,(\beta - \gamma)}{2\beta\gamma}$$

The second term on the right-hand side is of the second order of small quantities; and as β and γ should be within $\frac{1}{1000}$ of one another, while the resistance of the copper strip and mercury-cup connections is very small, it may be neglected. Therefore,

$$b = \frac{1}{2}\left(\frac{c'\gamma}{\beta} + \frac{c''\beta}{\gamma}\right);$$

put $\gamma = \beta\,(1 + \delta)$, where δ is small. Hence,

$$b = c'\,(1 + \delta) + c''\,(1 - \delta) = \frac{c' + c''}{2} + \frac{\delta}{2}\,(c' - c'').$$

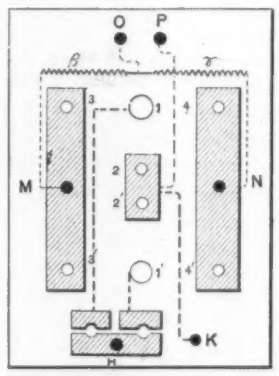


FIG. 2.—A MODIFIED FORM OF WHEATSTONE'S BRIDGE.

Here again the second term on the right-hand side is of the second order, so we get simply

$$b = \frac{c' + c''}{2};$$

or, the resistance of b is the mean of the two values of c and its shunt obtained by reversing.

The switchboard used by S. P. Thompson in carrying out Carey Foster's method of comparing resistances may easily be adapted to the shunt method. But a switchboard designed for the purpose is more convenient; this form is suggested.

In Fig. 2 the shaded parts represent solid brass or copper pieces, the dark circles binding screws, the light ones mercury cups. The coils to be compared are put between 1 and 2 and 1' and 2'. The terminals of the resistance box are connected to H K, so that by inserting a plug it can be put in parallel with either of the coils.

1 and 1' are then connected by copper bars either to 3 and 4' or to 4 and 3'. The equal resistances β and γ are of course wound on the same reel, and may be soldered permanently in place. M N are the battery terminals, O P those of the galvanometer.

If the coils to be compared differ as much as a B. A. unit does from a legal ohm, the resistances taken from the box will give the difference to .0002 ohm, and interpolation by means of the galvanometer deflections need only be resorted to beyond that. The sensitiveness of the method is of course limited by that of the galvanometer.

APPENDIX.

From the original equations,

$$c' = \frac{b\beta + b_1\beta - c_1\gamma}{\gamma},$$

$$c'' = \frac{b\gamma + c_1 - b_1\beta}{\beta}.$$

Hence, with $\gamma = \beta\,(1 + \delta)$ it follows

$$c' - c'' = -2b\delta + 2(b_1 - c_1) - (\delta\, b_1 + c_1).$$

The third term on the right-hand side is of the second order of small quantities; and in any symmetrical switchboard the second term will be exceedingly small so we have nearly

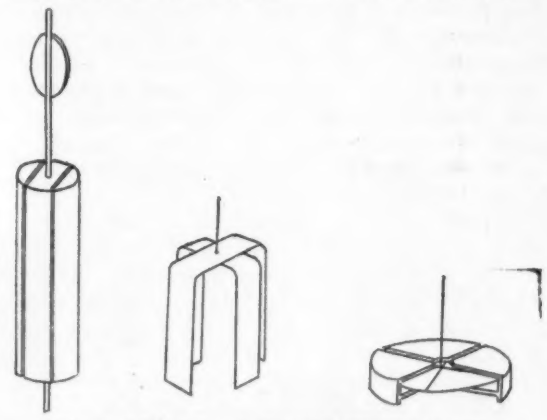
$$\delta = \frac{c'' - c'}{2b}.$$

The ratio δ of the nearly equal arms β and γ can thus be readily tested.

*From the *Philosophical Magazine*.

Pocket Electrometers.

At a recent meeting of the Physical Society, of London, Mr. C. V. Boys described modifications of electrometers adapted for portability. As quartz fibers increase the delicacy and diminish the disturbing influences affecting instruments, much smaller controlling forces can be employed than when silk is used for suspensions. He had, he said, pointed out some time ago the great advantages arising from making galvanometers small. Applying similar reasoning to electrometers, he remarked that making an instrument one-tenth the size of an existing one reduced the moment of inertia of the needle to $\frac{1}{1000}$, while the deflecting couple for given potentials would only be $\frac{1}{10}$ of its former value. The small instrument would, for the same periodic time, be 10,000 times more sensitive than the



FIGS. 1, 2 AND 3.—A POCKET ELECTROMETER.

Fig. 1—Cylindrical "needle," with four insulated sections containing a dry pile. Fig. 2—Cross-shaped "needle," consisting of a strip of platinum and a strip of zinc, charged by its own contact difference. Fig. 3—Disc-shaped "needle," with alternate quadrants of zinc and platinum, one of the enclosing quadrants being removed.

large one, provided the disturbing influences could be reduced in the same proportion. This, however, was not ordinarily possible, for any method of making contact with the needle, such as by a fine wire dipping into acid or mercury, prevented very small controlling forces being used. Still, by suitable devices a large proportion of the full advantage could be obtained. A freely suspended needle without liquid contacts was essential to success. The first instrument described was one in which the needle was cylindrical (Fig. 1), contiguous quarters being insulated and connected to the opposite ends of a minute dry pile placed within the needle; opposite quarters were then at the same potential, and at a different potential to the other pair of quarter cylinders. This was suspended within a glass tube silvered on the inside and divided into four parts by fine longitudinal lines. In such an instrument the needle and quadrants are reciprocal, and the deflection depends on the product of the difference of potential between the quadrants and that between the parts of the needle. Owing to the dry pile not being constant, the instrument was found unreliable, but when working at its best, a Grove cell would give 30 or 40 millimetres deflection. The next step was to make a cross-shaped needle of zinc and platinum (Fig. 2), and rely on contact electricity to keep the parts of the needle at different potentials. This bold experiment proved remarkably successful, for the instrument was very sensitive. A disc-shaped needle, with quadrants alternately zinc and platinum, was then employed, and by this a small fraction of a volt could be measured. The weight of the disc was only $\frac{1}{20}$ of a gramme, and the instrument could be turned upside down or carried about in the pocket with impunity. Another small instrument with the quadrants of zinc and copper (Fig. 3) was exhibited, and by rotating them through an angle of 90 degrees, so as to bring them in a different position relative to the different parts of the needle, a deflection of several degrees of arc was produced. In the course of his remarks Mr. Boys made several suggestions relating to ballistic electrometers and electrostatic Siemens dynamometers, and pointed out the possibility of instruments such as he had exhibited being of use in elucidating the obscure points in connection with so-called "contact electricity."

On the Mechanical Actions of Electrical Waves Propagated in Conductors.*

BY H. HERTZ.

The study of the forces to which a conductor is subjected when placed in the path of a series of electrical waves seems to me interesting for many reasons; among others, because these forces, when strong enough to be observed, enable us to study the waves quantitatively. I hoped to find in the nature and distribution of the mechanical forces a means of showing the existence of the magnetic force at the same time as that of the electric force.

In all the experiments hitherto made, the electric force alone has been manifested,† and as ordinary means do not demonstrate the magnetic force, it is of interest to study new methods with this purpose in view. I had an additional motive which formed the special aim of my research, and this rose from my hope of making observations of the waves in air under circumstances in which the movements produced could not be in any way attributed to forces acting at a distance. Owing, however, to the feebleness of the actions produced under these circumstances, I have failed in this endeavor, and have been forced to content myself with the study of the waves propagated in wires, although in so doing the principal interest of the experiments disappears. The mechanical action of waves propagated in wires can be attributed to the attractions of the quantities of electricity which accumulate on the wires, and to the currents which flow within them, and experiments made on these waves cannot thus serve as a crucial test between the old and new modes of regarding the phenomena.

After having studied various dispositions of apparatus, and obtained results which were quite concordant as regards the principal points at issue, I resolved to adopt the method of Mr. Lecher as being the most appropriate. Fig. 1 indicates the form of the apparatus. $A\,A'$ is the primary conductor, formed of two square plates of 40 centimetres side, joined by a brass wire 60 centimetres long, This wire is interrupted in the middle of its length, where the spark gap is placed. A small induction coil is used as exciter, worked by two accumulators, and producing sparks four centimetres long. The simple discharge of this little coil is certainly less powerful than that of a larger one, but the rapidity of the discharges compensates for the defect.

Facing the plates $A\,A'$, at a distance of 10 centimetres, are the plates $B\,B'$ attached to two parallel wires $B\,b$, $B'\,b$, p'aced at 10 centimetres from each other. These wires are each 6 8 meters long, and their ends are connected at $b\,b'$. At a distance, $B\,a$, which is variable, the two wires are also connected by a bridge piece $a\,a'$. For a certain position of this bridge, at a distance of about 1.2 metres from $B\,B'$, a very energetic oscillation is produced at $a\,a'$ and $b\,b'$. This represents the half length of a stationary wave, and, as Mr. Lecher has shown, it is produced by resonance between this vibration itself and the primary vibration produced in the air, between $A\,A'$ on the one side and $B\,a\,a'\,B'$ on the other. displacement of the bridge augments the period of one of these vibrations, and at the same time diminishes that of the other, so that with this arrangement the proper position of the bridge is determined in a very precise way.

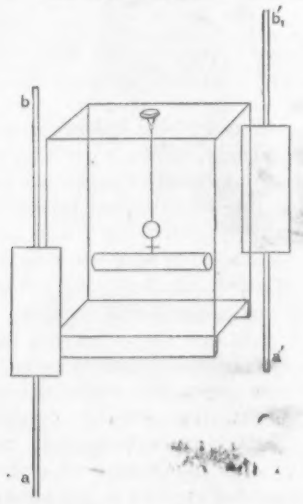


Fig. 2.—Hertz's Experiments on Electrical Waves.

Besides these general advantages the method also offers several special advantages for the purpose we have in view. As the forces to be observed are very small, it is necessary to carefully eliminate, as far as possible, all extraneous electrostatic actions due to the presence of conductors. This can be done with the disposition already indicated, as the wires, which it is necessary to bring near the bodies under test, form a system of continuous conductors. If in our experiments we surround the active parts with a metallic cage in connection with the nodal points $a\,a'$ and $b\,b'$ we shall protect them still more completely without altering the vibrations.

As the conductors which we submitted in turn to the action of the forces did not, like the resonators previously used, choose a vibration of fixed period from among the oscillations produced, the results obtained, in the first instance, were confused, until care was taken to produce a simple oscillation, whose wave length was perfectly definite, and which had its nodes in a strictly determinate position. In the above arrangement this condition is satisfied, for no one can doubt that the points $a\,a'$ and $b\,b'$ are the nodes of all the vibrations produced, and that among these vibrations the slowest only are reinforced sufficiently to attain an appreciable intensity. The fact that we confine ourselves to the study of the half of a wave length does not in the least detract from the general nature of the experiments. Finally, the vibration is of the same character whether the two wires are stretched out straight, or whether they lie near to one another, or curved in any way; just as the sonorous vibrations of air in tubes are the same whether the tubes are straight or bent.

We can thus easily make our vibration have all possible positions relatively to the body under test, although the latter is kept fixed. In fact, the relative positions in the

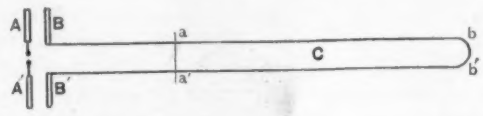


Fig. 1.—Hertz's Experiments on Electrical Waves.

experiments were always altered by moving the wires, even in cases where, for convenience, I speak as if the body under test had been moved.

For the measurement of the mechanical action of the electric force I have used a little cylindrical tube of gilt paper 5.5 centimetres long, and 0.7 centimetres in diameter. This tube was suspended horizontally by a thread of silk. A minute magnet was affixed for controlling purposes, and a small mirror was used to indicate the deflections. The entire system was suspended in a little glass box, and is indicated in Fig. 2. When it is submitted to the influence of the vibration, the tube deviates and tends to set itself in the mean direction of the electrical force. To obtain greater deflections, I brought the two wires near together in the neighborhood of the apparatus, and reinforced their effect near the extremities of the body tested by two small plates, as Fig. 2 indicates for a special case. Under these circumstances it was possible to obtain initial swings of over 100 scale divisions.

The regularity of these first swings was satisfactory, for on repeating the same experiment several times the results obtained did not differ from each other by more than a few per cent. As examples of the possibility of applying these deflections to purposes of measurement, I indicate two series of observations. The first shows the action of resonance. The apparatus was placed at c, the antinode of the vibration, and the wires $a\,b$ and $a'\,b'$ were brought near one another, as indicated in Fig. 2. The bridge piece $a\,a'$ was then placed at different distances e, measured from $B\,B'$, the induction coil was set working, and the value of i, the first swing, was observed. The corresponding values of e and i in the neighborhood of the maximum were as follow:

e 8, 90, 100, 110, 120, 130, 140, 150, 160 centimetres.
i 5.3, 10.0, 21.8, 51.2, 44.1, 19.3, 10.3, 5.7, 4.2 divisions.

If these values are plotted, the curve connecting them is quite regular, and shows a well-marked maximum between 110 and 120 centimetres. As a matter of fact, the impulsive swing reached a maximum value, $i = 60.6$ divisions, for $e = 114$ centimetres.

The second series of tests was made with the view of showing the diminution in the intensity of the vibrations from the antinode c to the node b. For this purpose, the distance between them was divided into 12 equal parts, and the apparatus was successively placed at the 13 points of division so obtained. The following observations were made:

No. =	1	2	3	4	5	6	7
i =	80.5	80.5	79.0	77.0	65.0	57.8	50.0
No. =	8	9	10	11	12	13	
i =	38.5	27.5	17.5	7.0	1.0	0	

These values vary in a sufficiently regular manner for the purpose of judging the form of the vibration, and for making it evident that it differs in a very noteworthy way from a simple sinusoidal oscillation.

Other experiments I have made show the direction of the electrical force in the neighborhood of the wires. The results are only such as would have been expected. In the space between the wires the needle tends to set itself along the line forming the shortest distance between them. Outside this space the needle tends to set itself perpendicular to the nearest wire. The extremities of the little tube seem thus always to be attracted toward the nearest portion of the wires.

For studying the magnetic force a circular ring of aluminium wire was used. The diameter of the ring was 65 millimetres, and that of the wire two millimetres. The ring was suspended so that it could turn about one of its diameters, and was furnished, like the cylinder previously mentioned, with a magnetic needle, a mirror and a glass cage. Fig. 3 shows the arrangement of the apparatus.

If for a moment we disregard the magnetic forces which we know to exist, we should expect that the ring, under the influence of the oscillations, would behave like the cylinder already described; and that the parts of the ring farthest from the axis of rotation, or the extremities of the horizontal diameter of the ring, would move in the same manner as the ends of the cylinder. We should also expect that the ends of the horizontal diameter would always be attracted toward the nearest portions of the wire by means of which the electrical oscillations are being propagated; and that these actions would be most marked at the antinodes of the vibrations, and would disappear in the neighborhood of the nodes. As a matter of fact, if the ring is actually suspended at the nodes $b\,b'$, as indicated in Fig. 3, the phenomena observed are quite different. In the first place, the ring does not remain at rest under the influence of the oscillations, but is acted upon by forces of the same order of magnitude as those evidenced by the action of the cylinder when placed at the antinode of the vibrations. Moreover, the direction of the deflection shows that the force between neighboring parts of the ring and cylinder is not an attraction, but a repulsion.

The repulsion is due to the oscillations, and its magnitude must depend on resonance, according to the same law as the electrical actions. The ring always sets itself perpendicular to the plane of the wire, whatever its position with reference to it, provided it lies within the contour $b\,b'$. We can deduce, therefore, from these experiments alone that, in addition to the electrical vibration, there exists a vibration of another kind whose nodes coincide with the antinodes of the former, and that the directions of the two classes of vibration are perpendicular to each other. Referring to the experiments, we can easily recognize the new vibration as magnetic. The rapidly oscillating magnetic force must, by induction, produce a synchronous alternate current in the closed metallic ring, and the reaction of this current produces a deflection. The magnetic force is a maximum at the nodes of the electric vibration, and at these points its direction is normal to the plane of the wire. That the action between neighboring portions of the ring and wire is a repulsion is easy to account for. The current induced in the ring is such as to neutralize within the ring the effect of the inducing current in the wire. The two currents accordingly flow in opposite directions and repel each other.

The other phenomena observed with the suspended ring can, without difficulty, be explained by the theory just given, although complications are sometimes introduced. Thus, for instance, with the arrangement indicated in Fig. 3, if the ring is moved away from the node b toward the antinode of the vibration, the repulsion diminishes very quickly, becomes nothing in a certain position, and then becomes an attraction increasing in amount until the antinode is reached. In a particular case the repulsion deflection at $b\,b'$ was 20 divisions, it disappeared altogether at about 95 centimetres distance from the ends, and became an attraction, the maximum value of which was measured by 44 divisions. In order to explain these results it is necessary to consider the simultaneous action of the electric and magnetic forces, the former being greatest at c,

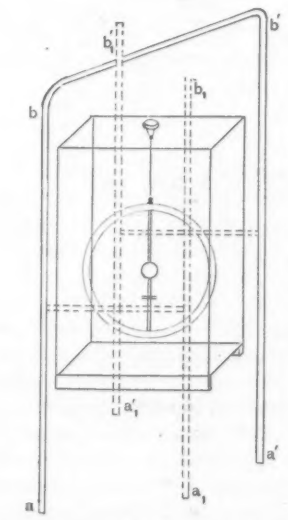


Fig. 3.—Hertz's Experiments on Electrical Waves.

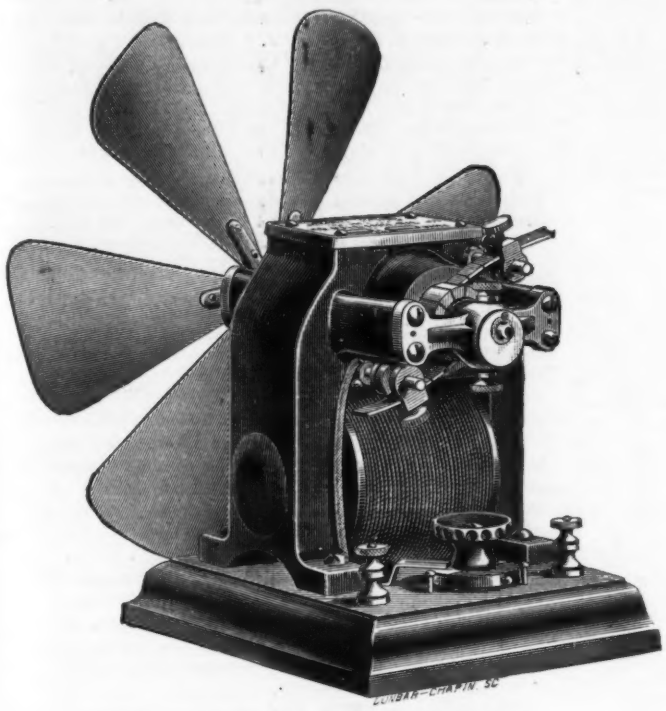
and the latter at $b\,b'$. We can verify this explanation by investigating the variation of the magnetic force after having eliminated the action of the electric forces. With this view place parallel to the wires $a\,b$, $a'\,b'$, two other wires of about 20 centimetres length, arranging the four wires symmetrically with regard to the equilibrium position of the ring, as indicated by the dotted lines in Fig. 3. Also join $a\,b$ to $a_1\,b_1$ and $a'\,b'$ to $a_1'\,b_1'$. In this way the electric action is evidently almost annulled, while the magnetic action is very little altered. We now observe a repulsion of the movable ring for all distances, diminishing to a minimum at the antinode of the electric vibrations. The minimum value is found to be four divisions. If the electric vibration were sinusoidal, the magnetic force would have disappeared at the node. The distribution of the electric force has already shown us that this hypothesis is not exactly correct, and we can thus understand the existence of magnetic force even at the antinode. The mechanical actions of the electric and magnetic forces, as theory indicates, are in general of the same order of magnitude. The predominance of one or the other depends essentially on the mutual actions of the nearest parts of the ring and the solid conductor. The more nearly these are like infinitely short wires, the greater is the relative importance of the magnetic force; while the greater the surface of the conductors, the more the electric force predominates.

*From *La Lumière Electrique*.

† When I have formerly referred to the nodal points of the magnetic waves, it was only on theoretical grounds, and not from actual observation.

The Holtzer-Cabot Fan Motor.

The Holtzer-Cabot Electric Company, of Boston, Mass., recently added to its already extensive works a department for the manufacture of electric fan motors. We illustrate on this page the ⅛ h. p. fan motor of this company. The machine shown in the cut has a Norway iron field-magnet core with malleable cast pole pieces and a drum armature with a very substantial commutator. Nothing but mica insulation is used. It has self-oiling bearings, with phosphor bronze journals, and in mechanical detail is well built. It is provided with a switch giving three changes of speed to the fan, and is wound for circuits of any potential. It is heavily japanned, and furnished plain or nickel-plated. A drum armature was selected as being more durable and efficient than a ring. The company does not believe that the demand of the present day is for a fan motor whose special merit is that it can be easily repaired, but rather that the demand is for one that does not get out of repair, and it has here made one which it is ready to guarantee to be permanently serviceable. Especial attention, however, has been given to making the machine interchangeable in every part, which is true of all the apparatus manufactured by this company.



THE HOLTZER-CABOT FAN MOTOR.

The Holtzer-Cabot Electric Company has secured the services of Mr. E. S. Pillsbury in this department of its works. Mr. Pillsbury has had an extended experience in the line of small electric motor manufacturing, having had employment with two pioneer manufacturers of fan motors, viz., the "C. & C." Motor Company and the Crocker-Wheeler Motor Company. His former connection with these companies will be of service in the production of this new fan motor.

The Hercules Electric Motors and Dynamos.

The accompanying cut illustrates a new motor which is placed on the market by the Zucker & Levett Chemical Company, of this city. As can be seen, the motor is of the inverted horseshoe type, in which the whole of the magnetic circuit is stamped out of one piece of Swedish iron, the number of shoes being bolted together to form the magnet frame.

The plates are thoroughly insulated to prevent the generation of Foucault currents and consequent heating. The field coils are separately wound on brass spools and the distance between the magnet cores is slightly larger than twice the depth of one coil, thus allowing them to be slipped over the core.

The plates of the armature, which is of the modified Siemens type, have teeth forming longitudinal channels on its periphery in which the coils are wound. These teeth, besides reducing the magnetic resistance, entirely prevent the coils from flying out due to the centrifugal force, and consequent burning out of the armature.

The magnet frame is bolted to an iron base, having iron standards and self-oiling bearings even in the smallest size of machines. By this method of construction an efficient and simple form of motor is obtained.

It is claimed that there is absolutely no sparking if the commutator and brushes are kept in fair condition, the magnetism of the field greatly overpowering that of the armature, even when the machine is working at full load.

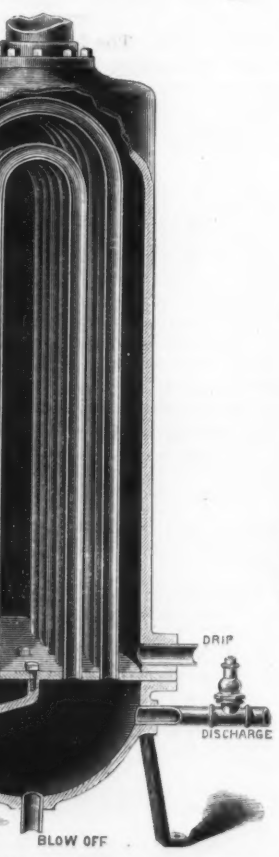
The automatic motors are mostly plain shunt wound with an armature of extremely low resistance. The fan motors are plain series wound and run a six blade 12-inch propeller fan at 1,600 revolutions per minute, taking one ampère at 120 volts.

The mechanical details of these machines have been very carefully worked out and all parts are adjustable. Quite a number of the Hercules fan outfits are in daily use and are giving universal satisfaction. These machines will be manufactured in all sizes from one-eighth h. p. up for both light and power.

Radway's Feed-Water Heater and Purifier.

This improved feed water heater is the result of long experience, obtained from handling the various types, and is manufactured by C. L. Radway, 136 Liberty street, New York City.

It makes use of the drawn seamless brass bent tube, both ends being secured into the one head or tube plate (as shown in cut) by means of a roller tube expander. There would seem to be, therefore, no danger of leaky joints caused by expansion and contraction of tubes. The shell being manufactured of cast iron will not pit or corrode.



RADWAY FEED-WATER HEATER.

The water being divided into many small columns, by means of the tubes, a much greater heating surface is in consequence obtained; therefore, coming as it does into almost immediate contact with the exhaust steam, it becomes heated in a very short time to from 200 degrees to 212 degrees without back pressure.

The settling chamber is divided into two compartments. As the water enters the heater, it passes up through the tubes and down into the settling chamber, then out of the top to the boiler.

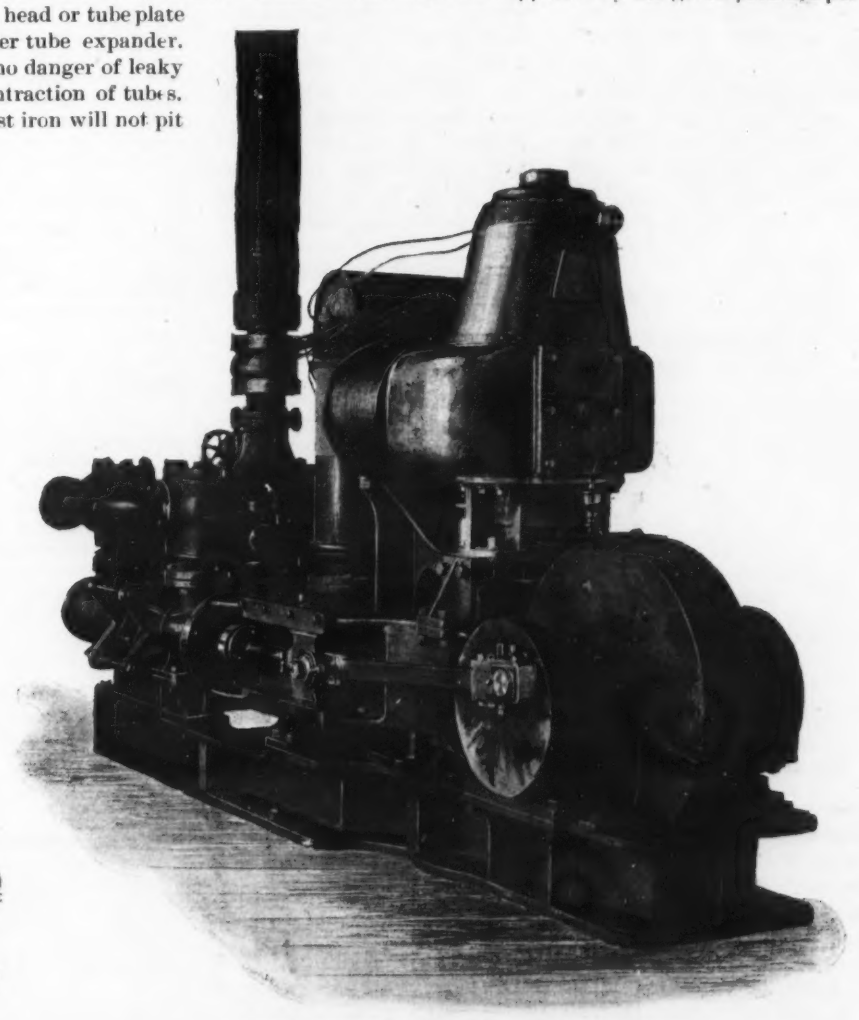
The chamber and the tubes are from 12 to 20 times larger than the inlet and outlet of the feed, thereby allowing a slow and free passage of the water, as well as plenty of time for the sediment to settle at the bottom, where it can be blown off. The area for the exhaust to pass around the tubes is from four to six times the size of the exhaust pipe

The Edison Electric Mining Pump.

This pump, as shown in the accompanying illustration, is a combination of a 25 h. p. Edison motor and a Blake double-acting pump, placed on a single bed-plate. The general arrangement of the pump is as follows:

The motor used is of 25 h. p. rated capacity, is series wound, and designed to operate at 800 volts; it can be supplied, however, wound for any of the standard voltages. The field coils are divided intothree sections, and the regulation of speed is effected by commutation of these sections by means of an ordinary car-controlling switch.

The armature shaft is connected by a worm driving a large gear wheel to a pair of crank discs, one on each side of the machine. Wrist pins, placed at an angle of 90 degrees with each other, carry the connecting rods operating the plungers of the double-cylinder pump, which is mounted on the same bed-plate with the motor. Each pair of plungers being connected together by outside rods work together like one plunger, and the connection with the crank discs being at an angle, one pair of plungers is drawing while the other is forcing water, thus making them double-acting. The size of each cylinder is five inches in diameter by 12 inches in length. The figures given in the following table on the performance of this pump were obtained during a recent test.



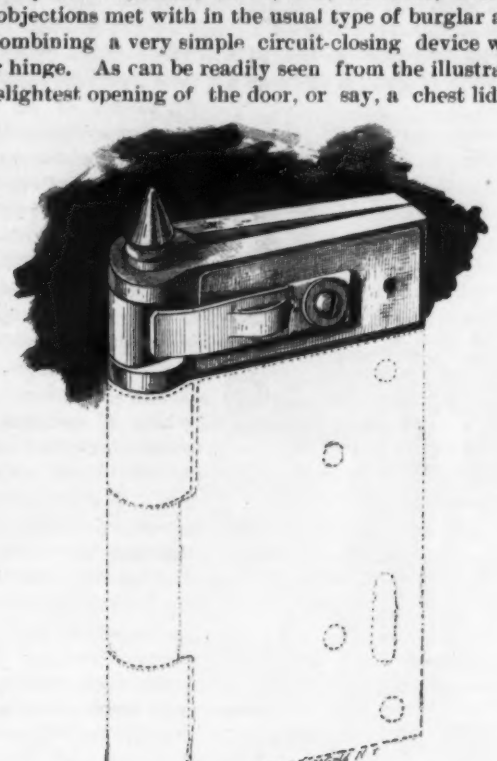
THE EDISON MINING PUMP.

The height given in the table below is the height of a column of water at 60 degrees F., with the barometer at 30 inches, which could be supported by the given pressure per square inch. The actual height to which the given number of gallons per minute could be raised would depend on the length and diameter of pipe and the number of bends, and in any case would be less than its theoretical height.

Strokes per min.	Press lbs. per sq. in.	Water delivered per minute.		Electric energy required. h. p.	Effective work done. h. p.	Commercial efficiency.	Theoretical height water.
		Galls.	Lbs.				
56	.....	.....	.....	8.04	.....	.....	.....
38	25	155.04	1 290	15.08	2.26	15.	57.73
37	50	150.36	1,256	15.08	4.4	29.8	115.46
35	75	143 8	1,188	18.	6.25	34.7	173.19
31	100	1 6.5	1.052	19.44	7.38	38.	230.92
30	125	122.4	1,018	20.4	8.02	43.7	288.65
28	150	114.24	950	23.46	10.	42 6	346.38
26	17	106.08	883	26.27	10.83	41.2	404.11
24	200	97.92	815	28.15	11.42	40.57	461.84

The Bleakley Door-Hinge Alarm.

Electric burglar alarms of many designs have been introduced for the protection of buildings by the giving of an alarm upon the opening of a window or door, but a large number of these devices have been of a complicated design, and rather liable to deterioration. Mr. William M. Bleakley, of Verplanck, N. Y., has, however, overcome the objections met with in the usual type of burglar alarm by combining a very simple circuit-closing device with a door hinge. As can be readily seen from the illustration, the slightest opening of the door, or say, a chest lid, will

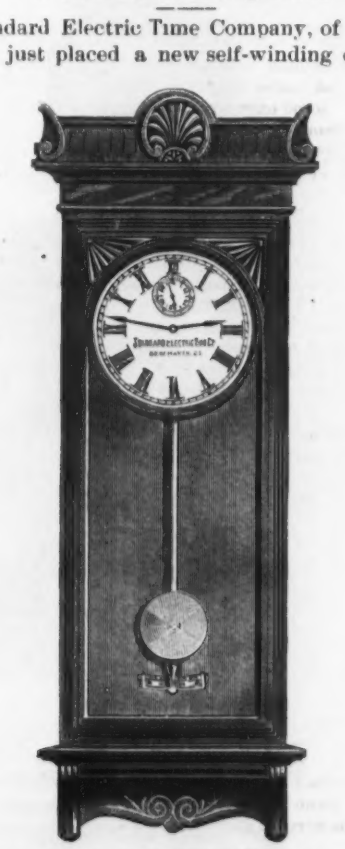


The Bleakley Burglar Alarm Hinge.

cause the isolated strip-spring to make a contact with the metal body of the hinge, thus closing an electric circuit. The good features of the invention are, that while a very slight movement makes contact, still no delicacy of adjustment is required, and that the cost of fitting to a door is very small. The hinge is made in most sizes in two parts, as shown, so that but one screw need be removed to detach the alarm or to adjust it. In the original form described in The Electrical World last fall, the connections were placed directly on the hinge, but to increase the convenience and adabtibility of the device are now on a separate leaf, as shown—a very decided improvement.

A New Self-Winding Clock.

The Standard Electric Time Company, of New Haven, Conn., has just placed a new self-winding clock on the



A Self-Winding Clock.

market which is very simple in its construction and very neat in its appearance.

The springs for operating these clocks are kept wound to a uniform tension by two cells of battery operating upon an electromagnet at regular intervals, which does away with the electric motor ordinarily used for this purpose, making it much less complicated and less liable to get out of order. Being kept at a uniform tension these clocks are more likely to keep excellent time.

A synchronizer or setting device is also furnished, so arranged that the hands may be set forward or backward by simply pressing a key in the bottom of the case; or, they may be set from a distance by attaching wires from the top of the case to a key or telegraph instrument, which will make them very valuable for railroads.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

The United Electric Securities Company invites proposals for sale to the company of $50,000 first series collateral trust sinking fund five per cent. bonds. This call is in addition to the previously issued call for $30,000 first series and $20,000 second series bonds.

The Western Union Stockholders.—The statement has been made by Jay Gould that the transfer-books of the Western Union Company show a constant absorption of the stock for investment, and the following table is presented as proof of the statement:

	Shares in name of Brokers.	Shares in name of Investors.	Number of Stockholders.
Dec. 20, 1886	218,142	5 1,958	3,767
Dec. 20, 1887	305,685	55 ,315	2,843
Dec. 20, 1888	313,088	518,912	3,021
Dec. 20, 1889	274,286	527,714	3,4 6
Dec. 20, 189	221,036	610,164	3,801
June 20, 1891	18.,738	673,262	4,045

The Effect of the Lamp-Patent Decision.—The immediate result of Edison decision, which was announced last week and was published in full in the last issue of The Electrical World, was not so marked in its effect upon the market value of the stocks of the companies interested as had been anticipated by some financial men. On Tuesday morning the Edison general stock advanced from 96 to 105, but later in the week declined somewhat and closed on Saturday at 101. The Thomson-Houston stock declined only an insignificant amount under a sharp raiding by interested brokers, only to recover later in the week to nearly its previous figure. The price of Westinghouse stock was not effected by the decision against the United States company.

As to the effect of the decision on the Edison companies a good authority said last week: "The effect of this decision will be to largely increase the revenues of the Edison General company as well as those of the local companies established under the Edison system. These local companies have the right to sell lamps in the territory assigned them, and so all royalties in their several districts will accrue to these local companies. For instance, the Edison Electric Illuminating Company of New York City has the exclusive right under the system to operate the Manhattan Island. It will therefore receive all royalties upon lamps installed within this district. The General company gets a benefit from the increased value of territory, its monopoly rights and the increased profits of local companies as they may accrue in the form of dividends on stocks held by the General company. The effect of the decision will be extremely favorable to the Edison Electric Illuminating Company, which is already showing exceptional development of its business. The net returns for June were 100 per cent. more than for the same month last year, and the first six months of 1891 show an increase of 50 per cent. over the business of 1890. The company will pay its twenty-fifth consecutive quarterly dividend Aug. 1."

The Westinghouse people claim "that the decision will not seriously affect them. The patent has only a few years more to run, and is only sustained in part by the decision, which at best can only affect the manufacture of incandescent lamps, which is a comparatively small part of the business. Indeed, no incandescent lamps have been manufactured at the Westinghouse factories in Pittsburgh and Newark for over two years. The United States Electric Lighting Company, against which the decision was rendered, proposes to take an appeal at once."

The Thomson-Houston company, in respect to the decision, issues the following: "The Thomson-Houston company is well satisfied with the Edison decision in reference to incandescent lamps. It will have the effect of closing all the small companies who have been pirating in this field, and will far better subserve the general electrical interests than would a contrary decision, which would make this invention public property and allow any one to manufacture. It will vastly enhance the value of electrical patents and so strengthen the strong companies and drive out of business the smaller enterprises which have been manufacturing generally regardless of patents. While this suit is not against the Thomson-Houston company, that company is of course interested in the result. The decision rendered was foreseen, and the Thomson-Houston company some time since perfected arrangements with this in view, which effectually protects them in reference to future business. The case will probably be appealed to the new Court of Appeals and a final decision cannot be had for a year or more."

Chicago Quotations.—Col. S. G. Lynch, broker, 153 Monroe street, Chicago, furnishes quotations on telephone and electric light stocks as follows:

Chicago	$230@$240	Cumberland	$60@ $62
Central Union	51@ 52	Wisconsin	118@ 120
Michigan	82@ 83	Bell of Missouri	160@ 165
Great Southern	30@ 3	Iowa Union	20@ 22
Colorado	31@ 36	Missouri and Kansas	54@ 56
Rocky Mountain Bell	40@ 43		

ELECTRIC-LIGHT STOCKS.

Chicago Arc Light and Power	$99@$100	Chicago Edison Co.	$145@$150

NEW INCORPORATIONS.

The Illinois Electric Welding and Manufacturing Company has been incorporated at Chicago with a capital stock of $20,000. The incorporators are P. Harvey, J. W. McGeath and R. L. North, Jr.

The Self-Generating Power Company has been incorporated at Chicago, Ill., to do a general manufacturing business. The capital stock is $2,500,000. The incorporators are: D. L. Cook, M. M. Wood and D. L. Coe.

The World Incandescent Lamp Company has been incorporated at Chicago, Ill., to make lamps. The capital stock of the company is $100,000. The incorporators are Geo. W. Waite, Manly M. Tilton and J. H. Park.

The Newmarket (N. H.), Electric Light and Power Company, incorporated recently, has organized into a stock company. A special town meeting has been called for, to see if the town will raise $600 a year for lighting its streets.

The Gaston Electric Manufacturing Company, of Sparta, Ill., has been incorporated, with a capital stock of $125,000, to manufacture general electrical apparatus. The incorporators are J. E. Gaston, D. P. Barker and J. H. Rosborough.

The Chicago and Evanston (Ill.) Electric Railway Company has been incorporated to operate a street railway system. The capital stock is $500,000. The incorporators are: J. L. Cochran, D. H. Landerbach, F. S. Gorton and Alexander Clark.

The Wisconsin Gas Company, of Chicago, Ill., has been incorporated, with a capital stock of $2,000,000, to build and operate gas and electric plants for all purposes to which their use may be adapted. The incorporators are Wm. J. Lee, Truman M. Hall and Calvin C. March.

The Carolina Light and Power Company has been organized at Aiken, S. C., with a capital stock of $20,000. R. A. Chafee, B. F. Turner and G. W. Croft are interested. The business of the new company will be to furnish and supply Aiken with electric light and water, etc.

The Berkeley and Lorin Water and Light Company of San Francisco, has been incorporated, with a capital stock of $250,000, to operate an electric-light plant and water-works for Berkeley and neighboring towns. The incorporators are W. L. Sheldon, Wm. F. Martin and J. A. Mallon.

The Herzog General Electric Company was organized at Newark, N. J., on July 10, with a capital stock of $1,000,000, for the manufacture, sale and exploitation of all kinds of electrical appliances and other articles. The promoters are F. B. and P. Herzog, of New York City, and G. G. Frelinghuysen, of New Jersey.

The San Antonio Light and Power Company, with a capital stock of $240,000, has been incorporated at Pomona, Cal., to manufacture light, power and heat near the waters of San Antonio Creek. The gentlemen largely interested are Thos. R. Bard, Hueneme; N. W. Blanchard, Santa Paula, and John D. Hooker, of Los Angeles.

The Amador Electric Railway and Light Company was formed recently at Sutter Creek, Amador County, Cal., with a capital stock of $500,000, for the purpose of constructing, operating and maintaining a railway, and telegraph and telephone service along the railway. E. C. Voorhees, R. C. Downs and S. N. Knight, all of Sutter Creek, are interested in this company.

The Carpenter Electric Light and Motor Company, of the District of Columbia (incorporated in West Virginia), with its principal office in Washington, D. C., was recently incorporated with a capital stock of $100,000. It will deal generally in all kinds of electrical appliances. The promoters are H. H. Carpenter, J. E. Carpenter and J. T. Burch, of Washington, D. C.

The Harvey Transit Company, of Chicago, Ill., was recently incorporated, with a capital stock of $150,000, to construct and operate a horse or dummy railroad in Harvey, Ill., and contiguous territory to be operated by animal, steam, electric or other power. The incorporators are Hiram H. Badger, Chas. D. Stanwood and Willets G. Wanzer.

The Beatrice Light and Power Company, of Beatrice, Neb., with a capital stock of $50,000, has been incorporated to construct and maintain a system of gas and electric light works for light, heat, power, etc., in Beatrice and other places, as desired, in Gage County, Neb. The incorporators are Fred. J. Maxwell and William Pickrell, of Beatrice.

The Shelbyville Water and Light Company (incorporated in W. Va.), has been incorporated with a capital stock of $50,000, for the business of operating electric light plant, gas, water and power works at Shelbyville, Ill. Its principal office is in New York City. C. W. Pelham, New York; H. J. James, Mt. Vernon, N. Y.; J. Frank Waters and A. F. Babcock, of Brooklyn, N. Y., and C. B. Ludwig, of Roseville, N. J., are connected with the company as promoters.

AFFAIRS OF THE COMPANIES.

The Bell Telephone Dividend of $9 per share was paid last week, the total amount necessary for the dividend being $1,350,000.

The New York Belting and Packing Company is about to place upon the market for public subscription the first mortgage bonds of the company.

The Edison General Electric Company, has declared a quarterly dividend of two per cent., payable Aug. 1, to stockholders of July 11. The transfer books were closed July 11, and will be reopened Aug. 3.

Westinghouse Annual Meeting. The deferred annual meeting of the Westinghouse Electric and Manufacturing Company was held in Pittsburgh on the 15th inst. The plan for the reorganization of the company's affairs, which is in brief as follows, was adopted unanimously by the stockholders: Four million dollars of seven per cent. cumulative preferred stock is created, of which $3,000,000 has been taken at par by the reorganization syndicate, to care for the company's floating debt and provide additional capital. The assenting stockholders give up 40 per cent. of their stock, aggregating over $2,500,000, par value, for the use of the company, and are given upon the 60 per cent. of stock which they retain a seven per cent. preference over the small amount of non-assenting stock remaining out. The utmost harmony prevailed at the meeting, notwithstanding reports that the plan would meet with opposition from a small minority. The following named gentlemen were chosen to form the new board of directors of the company: August Belmont, Henry B. Hyde, Marcellus Hartley, Geo. W. Heard and Brayton Ives, of New York; Charles Faircild and Charles Francis Adams, of Boston; and George Westinghouse Jr., A. M. Byers and Lemuel Bannister, of Pittsburgh. The gentlemen representing the syndicate in attendance at the meeting were shown through the works of the company, and expressed themselves as being highly pleased with the condition in which everything was found.

Special Correspondence.

NEW YORK NOTES.

Office of The Electrical World,
167-177 Times Building, New York, July 20, 1891.

The Music Hall Switchboard.—The new slate switchboard for the Carnegie Music Hall in this city, which is being built at the Thomson-Houston factory in Lynn, Mass., is said to be nearly ready for shipment, and when received at the music hall will be ready to be set up and be put in operation.

Mr. Julian Scholl, of Julian Scholl & Co., 40 Cortlandt street, New York City, mechanical engineers, has been appointed sole agent for New York for the Weston Engine Company, of Lambertsport, N. Y. Mr. Scholl has had considerable experience in the engine business, and his ability, combined with commendable qualities of the Weston engines will no doubt cause many sales of the latter apparatus in this state.

Search Light Manœuvers.—Five of the United States warships are now anchored in the North River alongside of New York City. On Thursday evening this week at 8:45 o'clock the naval be-

talion is to board the cruisers and war ships and will have a practice drill with search lights and night signals. This includes a torpedo attack without the torpedo, the object of the boats' crews opposed to the handlers of the search lights and protectors of the ships being to get within torpedo reach without being discovered.

Mr. Louis Walsh, well known to the trade through his connection with the Crosby Electric Company and with Messrs. Alexander Barney and Chapin, has associated himself with Mr. Charles G. Taylor, a well-known merchant of New York. The firm name is now Taylor & Walsh. The company has established a factory and offices at 100 South Fifth avenue, where it will manufacture the "Fibrous" battery, both dry and liquid, also the Leclanché fibrous porous cups. Both the battery and porous cups are new inventions, and the tests show excellent results.

To Resume Subway Building.—At a meeting of the Board of Electrical Control held last week the difficulty with the Subway Construction Company, which has for some time delayed the work of building subways, was adjusted and the Company will at once resume its work. The Corporation Counsel gave it as his opinion that proceedings for forfeiture of the Company's bond could not be begun under the existing circumstances. A resolution was passed instructing the Company to go ahead with its work. In the six months prior to July 1st 3,156 poles were removed from the streets and 29,425,145 feet or 5,573 miles of wire was taken down. L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 8, Cook Building, cor. Franklin and Congress Sts.,
BOSTON, Mass., July 18, 1891.

The Altham Motor Company expects to have a street car equipped and running with its motor about September 1st.

The Uxbridge and Northbridge (Mass.) Electric Company held its annual meeting last week and elected officers for the ensuing year.

The New England Telephone and Telegraph Company moved into its new and commodious quarters at the corner of Milk and Oliver streets on Saturday last.

The West End Railway is to equip its line to Dorchester, Mass., for electricity at once, which will prove a great convenience to residents in that portion of the city.

The American Graphophone Company, of Washington, D. C., the Bridgeport, Conn., factory of which was discontinued some time ago, has established a laboratory in the latter city. It will be under the supervision of Mr. Devereaux Elms, but who has recently been employed at the company's Washington plant.

The Electro-Novelty Company, of 9 Knapp street, Boston, has issued a neat little pamphlet entitled "Simplex Treatise No. 1," which gives a detailed description of the toy motors, batteries and other novelties manufactured by the company, and is something that the average boy can thoroughly understand and enjoy.

The Edison Electric Illuminating Company, No. 3 Head place, Boston, has just issued a very neat and concise book of rules and instructions for wiring residences or business places for the Edison light or power. These instructions, while not claiming to cover special cases, go over the ground very thoroughly and will no doubt be greatly appreciated by the patrons of the company and others intending to put in light or power.

The Thomson-Houston Pay Roll of last week included the names of 2,716 employés. The names of this large force of men are kept on file in the paymaster's office by means of a card catalogue system. Two copies of this card index of employés are kept at the factory, one being in the possession of the paymaster, and should there be a sudden call for any one of the 2,700 employés his name could be found almost instantly and his location in some one of the factories given. Each person leaving the company has a discharge card, and these are kept on the same plan as the card catalogue of employés. On this card is a record of the employé's work and the cause of his leaving the company, so that should he again apply for work his former record can be at once consulted.

Electric Cars in Boston.—The satisfactory service of the electric cars on the West End Street Railway in Boston is vouched for by the Boston *Herald* editorially in these words: "More people are being carried over the street railroads of Boston this summer than at any previous season, and it is no more than justice to the West End Railroad Company to say that they have never been carried so comfortably. The large electric open cars employed on the Shawmut avenue lines are now abundant enough in number to take all the passengers which the street can carry on a surface road. In these days of severe hot weather it is no small comfort to feel that, however heavily the cars may be loaded down at times there is no suffering caused to horses as the result. C. A. B.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, Ill., July 18, 1891.

Mr. Clift Wise, chief engineer of the Interior Conduit and Insulation Company, is in Chicago en route from Minneapolis to New York.

Mr. C. M. Giddings, president and general manager of the Sioux City (Iowa) Engine Works, was a welcome visitor in Chicago this week.

Mr. L. P. Parker, superintendent of the Postal Telegraph Company at Chicago, Ill., is spending the summer at Manitou Springs, Colo.

Mr. James R. Dee, general manager of important electrical interests in upper Michigan, was a welcome visitor in Chicago during the week, returning to Houghton on Friday evening.

Mr. Herbert E. Goodman, general manager of the Sperry Electric Mining Machine Company, Chicago, is visiting many of the more important coal mines, and combining business and pleasure on an extended trip.

Mr. James Allison, of Cincinnati, O., has been appointed Chief of the Department of Machinery by the Board of World's Fair Directors. Mr. Allison was general manager of the Cincinnati Industrial Exposition.

The Electrical Engineering Company, Monon Building Chicago, has secured the agency of the Interior Conduit and Insulation Company, of New York, for several of the Western States. This company has placed interior conduit in some of the large buildings and apartment houses in Chicago.

Cabling Exhibit at the Fair.—Mr. George Ward, manager of the Commercial Cable Company, New York City, writes to Chief Barrett that he will make a big display of cable instruments at the exposition. He expects to show a model of a complete repairing steamer, illustrating the method of repairing cables.

The Chicago Electric Manufacturing Company, of 73 West Jackson street, Chicago, has not dissolved, as recently reported, but is doing more business than ever in manufacturing specialties to order. The company is now engaged in filling an order for 10,000 metal specialties for an Eastern company.

Mr. A. M. Robertson, general manager, and Mr. E. S. Corser, director, of the Minneapolis Brush Electric Company, have returned from a trip to the East. The object was to make a thorough inspection of the manner of underground wiring in use in the various cities, and to decide which one would be the best for their company.

Mr. Charles T. Yerkes has placed on trial a Low adjustable car having a device by means of which the sides can be quickly raised, and the seats, extending the full length of the car, reversed to face outward, converting a closed car into an open car or vice versa, three minutes being required to make the change. It is said to be well adapted for electric lines in moderate climates, where but one set of cars is desired for both winter and summer use.

The World's Columbian Exposition.—Of the 243,000 feet of floor space in the main building and 95,000 feet of gallery space that will be at the disposal of Chief Barrett, more than 200,000 feet have already been applied for, and it is worthy of note that the electrical department has been notified of the action of the board of directors of several of the smaller electrical companies who have authorized the expenditure of from $5,000 to 315,000 in preparing and maintaining a suitable display at the Columbian Exposition. Such action is very gratifying to Chief Barrett.

Beloit, Wis., is one of the prettiest towns in the northwest, has a population of about 8,000, a number of factories, some of which, like the Williams Engine Company and the Eclipse Clutch Works, are located near the city limits, and all of which employ many hands, a prominent university that is well endowed, an electric light company operating the Western electric arc and Eau Claire National incandescent systems, and yet has not a street car line, though it has many streets not pleasant to walk about on during wet weather. There is now some talk of starting a storage battery line there, but no franchise has yet been granted.

Subways and Underground Work.—With reference to the question of piping room before the Economic Gas Company, a Chicago paper publishes a most interesting cut showing a section of La Salle street at the intersection of Washington street. The following underground work is to be seen: One large Postal Telegraph Company's conduit, one large conduit of the Chicago Underground Company, one 36-inch water main, six gas mains, three Western Union Company's pneumatic tubes, one city conduit, conduits of two cable-road companies, one Western Union and Baltimore & Ohio company conduit, two Edison conduits and the city sewer main.

The Calumet & Hecla Mine will shortly have an electrical mining plant installed, and it is to be hoped that a careful record of the service and cost will be maintained from the start. As the Calumet is a comparatively dry and clean mine, the work of installation can be done far more quickly than in the mines on the Gogebic range, for instance, where moisture and falling rocks are ever-present evils. The electrician in charge is Mr. Fred. N. Bosson, and, as he fully appreciates the unlimited means and excellent facilities at his command, there is no reason why this work when completed should not be the model plant of its character, and do giant's work in hastening the application of electricity in all mining work.

Mr. F. H. Soden, formerly in charge of the engineering and construction department of the Chicago office of the Thomson-Houston Electric Company, has formed an alliance with Mr. George H. Bliss, under the firm name of Bliss & Soden, as consulting and contracting electrical engineers. The headquarters of the new company are in rooms 612 and 614 Temple Court, Chicago. The company makes a specialty of electric-railway work. Mr. Soden's ability as an engineer has been clearly demonstrated in many of the installations made during his five years' experience in the Edison company, in addition to the same length of service with the Thomson-Houston company. Both Mr. Bliss and Mr. Soden are pioneers in the Western electrical field, and are favorably known in the sphere. F. DE L.

KANSAS CITY, Mo., July 17, 1891.

Mr. J. Berton Wood, of the Great Western Electric Supply Company, of Chicago, dropped in on us last week.

Mr. Edward Lasell, president of the Southwestern Electric Supply Company, with headquarters in New York Life Building, reports a better feeling in electrical circles.

The Thomson-Houston Electric Company, ably represented by F. D. Rusling and C. D. Ross, is cosily quartered in the New York Life Building, and doing a nice business.

Mr. Willard F. Matteson, electrician of the Accumulator Company, of Chicago, Ill., stopped off a few hours last week on his way from Topeka, Kans. He reports business in Kansas as prosperous.

The Consolidated Cities across the Kansas River are agitating the question of municipal lighting, and if reports be true a committee will be appointed to confer with the Consolidated Electric Light and Power Company for the purchase of its plant at Riverview. Inquiry at the company's office failed to elicit anything further than that the preliminary steps were being taken by the city, and that a strong public sentiment is in favor of the new move.

The New Coates Hotel has the largest private electric light plant in this city. It consists of four Edison dynamos, capable of supplying nearly 3,500 16 c. p. lamps, and furnishes light for both hotel and opera-house. At present the hotel uses 1,700 lights, while the opera-house has 550 lights. In case of accident or break down the entire circuit can be switched over to the central station circuits. Mr. W. T. Osborne, a practical electrician, has charge of the plant.

A Well-Known Electrical Engineer of this city expresses the belief that the West is on the eve of great electrical activity, and the next twelve months will witness the projection of more enterprises of this nature than ever before. Certainly the indications all point this way. The assurance of large crops has brought to electrical houses of this city hosts of inquiries from all over the West and Southwest, and a rapidly increasing trade is anticipated this fall. H. D. E.

SOUTHERN NOTES.

NORFOLK, Va., July 18, 1891.

Montgomery, Ala.—It is said that a telephone line between this place and Wetumpka will be built.

Norfolk, Va.—It is stated that the Norfolk and Atlantic Terminal Company intends building an electric railroad.

Louisville, Ky.—The Thum Electric Safety Company was recently organized here with a capital stock of $1,000,000.

St. Bernard, La.—The erection of an electric light plant in St. Bernard is talked of, and steps are being taken to secure its location.

Asheville, N. C.—The contract for electric power to operate the Asheville and Sulphur Springs Railway Company's plant has been let.

Norfolk, Va.—A scheme is on foot to build an electric railroad from Port Norfolk to Portsmouth. Mr. M. W. Mason, of Norfolk, is interested.

Meridian, Miss.—The Edison Electric Power Company has been organized. The company will soon begin the erection of an electric light plant.

Riverside, Tex —This city is trying to secure the location of an electric light plant. It is reported that a company is being organized to put the plant in operation.

Columbus, Ga.—This city is to have an electric street railway three miles in length. Mr. Eugene T. Lynch, Jr., has secured the contract for building the line, which is to be in operation in 75 days. The road will be built by the North Highlands Company.

Norfolk, Va.—The Electric Company of Virginia has been compelled to increase the capacity of its plant, and is erecting an additional building 38×68 feet, in which are placed two additional 100 h. p. boilers, one 250 h. p. Corliss engine and two Edison dynamos, which will have a capacity of 1,200 incandescent lights. The capacity of the company's works, including the recent additions, is 400 h. p. boilers and engines. These furnish 19,000 incandescent lamps, 190 arc lamps. The works of the company are situated in Williamson's lane, while their office is at 128 Main street. W. W. Chamberlain is president, and James L. Belote superintendent.

Washington, D. C.—The Commissioners of the District of Columbia lately passed upon the application of the Secretary of the Navy for permission to run a telegraph line from the navy yard, Washington, to the naval ordnance proving ground at Indian Head, Md. The law forbids the stringing of any additional wires in the city of Washington, but there will be no trouble with the rest of the line. They will probably cross the draw at the Anacostia bridge on a cable. The route will be 26½ miles long, extending from the navy yard to the Anacostia bridge, over the bridge to Anacostia, and from the latter place past the Government Hospital for the Insane, by Nichols avenue, through Prince George's County to Indian Head.

Richmond, Va.—A large number of citizens, including electricians, railroad men and business men, assembled at the corner of Seventh and Leigh streets recently to witness a test of the current breaker of the Johnston Safe Automatic Electric Company. This device is designed to render electric light telephone, street car and fire alarm lines perfectly safe when a break occurs in them; the repairing of wires within given distances can also be successfully accomplished without the cutting off of the current from the end of the line. Mr. Johnston, the inventor, is a well-known civil engineer of Richmond, and a member of the American Institute of Electrical Engineers. The invention is considered a useful one, and, it is thought, will prove of benefit to the electrical world. The test was very successful. The officers of the company are John Rutherfoord, president, and S. B. Jacobs, secretary and treasurer. V. N. B.

ENGLISH NOTES.

(From our own correspondent.)

LONDON, July 8, 1891.

Institution of Electrical Engineers.—Over 800 guests responded to the invitation of the President of the Institution of Electrical Engineers to a *Conversazione* at the Royal Institute of Painters in Water Colors on Monday last. Among those present were Messrs. W. J. Karner and E. L. Corthell, who have, I believe, come over to this country on a mission in connection with the Chicago exhibition.

Tramways Institute and Electric Traction.—At the annual meeting of the Tramways Institute of Great Britain, held in London last week, the chairman stated that a recent visit of his to the United States had convinced him of the decided superiority of electric traction over both horse and steam power for tramway purposes. A German member stated that in one way or another electric traction came out 40 per cent. cheaper than either of its competitors. Some encouraging figures were given with regard to the receipts from the three-mile line at Birmingham, which has been worked for some little time past by means of accumulator cars. The receipts per car mile when horses were employed were about 10d., as against 14¼d. since electric cars have come into use.

Technical Examinations.—Although it is of course impossible to make engineering examinations anything more than a rough approximation to actuality, it has long been a complaint in this country that examinations bear no resemblance whatever to the real thing. The authorities of Finsbury Technical College, who are nothing if not practical and progressive, have determined to make an effort to remove this reproach, and in future examinations no questions will be set which require a mathematical knowledge greater than that which the engineer finds himself in need of every day, and a degree of accuracy greater than that which can be obtained by using a slide rule will not be insisted upon. Pocket-books and similiar aids, so familiar to the real engineer, will also be allowed to the examinees.

Electrical Manufacturers' Profits.—Although neither the heavy electrical manufacturing nor the business of supplying electric light are particularly remunerative in this country, the lighter branch of the industry, such as the manufacture of art fittings, lamps, etc., has proved to be a financial success for some time past. The Edison-Swan company, so long as it was involved in expensive and tedious litigation, and so long as it mixed up heavy engineering business with lamp manufacturing, was unable to give its shareholders any return for their money. Now, however, that this company has triumphed in the law courts, and has shed all its extraneous business, it is in a position to give its shareholders a handsome return. Thus at the last meeting of the directors of this company it was resolved to recommend the shareholders to declare a dividend of seven per cent. per annum for the year ending June 30, 1891, and a further dividend of 10 per cent. in respect of the arrears on the cumulative preference shares.

Answers to Correspondents.

Questions to be answered in this column must be of general electrical interest, and must be accompanied by real name and address as a guarantee of good faith. No notice will be taken of questions regarding apparatus unless enough details are given to permit a definite answer, and no dynamo or motor designing will be done.

House Lighting by Primary Batteries.—Can you inform me if I can practically light a house with primary cells? There seems to have been a great deal of controversy with regard to the merits of the primary battery for supplying large currents.

O. W.

We have answered such queries as the above many times in THE ELECTRICAL WORLD, and have in most cases seemed to be rather severe upon the primary battery. We have given the advice of

"Don't." This is not because the primary cell is inefficient, but because of its expense and the care necessary.

Storage Batteries in Central Stations.—Will you please answer through your correspondence column the following questions? (1) Has the storage battery been perfected to such an extent that it can be utilized by a central station for supplying 500 incandescent and 30 arc lamps for three or four hours, when the engines or dynamos have met with such an accident as to compelt shutting down? (2) Is there a central station in this country which uses a storage battery for that purpose? (3) If there is a battery which can be successfully so used, what would be its approximate cost? J. R. V.

(1) and (2) Yes. A large number of isolated plants and several central stations have the system in use. (3) There are not sufficien data given to enable us to estimate. We would advise you to solicit the estimates of some of the accumulator companies.

Horse Power for Arc Lighting.—Please inform a reader of your paper: (1) What the rule is for determining the horse power required in connection with arc lights, say 2,000 c. p. (2) What is the rule for determining the number of arc lights necessary to light a town? G. G. D.

(1) An allowance of one horse power per light is usually made. (2) It would be difficult to give a rule for determining the number of 2 000 c. p. lamps required for a given area when that area is covered with houses and trees. Mast arms carrying such lamps are usually placed every second or third block along the street, arranged so that a lamp is hung at each crossing. The lamps at the crossings are hung from longer mast arms, which are placed at an angle of 45 degrees to either street, thus favoring equally both the main and the cross streets.

News of the Week.

THE TELEGRAPH.

Bifton, Pa.—A large force of men will shortly commence building a telegraph line along the route of the Delaware, Susquehanna & Schuylkill Railroad.

Jamestown, N. H.—Manager Sloane, always alive to the interests of his company, has established Western Union telegraph offices at Lakewood, Chautauqua and Pt. Chautauqua for the summer. S B. Drake has charge of the Lakewood office in the Sterlingworth. D. D. Skinner will look after the interest of Chautauqua patrons.

Atlantic Telegraphy and the McKinley Bill.—Sir John Pender, speaking at the meeting of the Direct Cable Company in London last week, stated that there had been a positive decline in Atlantic telegraphy since the McKinley law went into operation. He did not, however, attribute the decline solely to the McKinley law, but thought it was partly due to the depression in trade and to competition.

New York City Telegraph System.—The telegraph system of the Police Department is about to undergo a radical change. The present system is slow, antiquated and unreliable. For a week past a new system in the method of transmitting messages between police headquarters and station-houses has been given a test, and so far has met with the approval of all who have seen it work. Under the present system of dial telegrapning and reading, an operator, no matter how expert he may be in the manipulation of the keys on the dial, cannot send more than 15 words a minute, and there are very few, if any, operators or police sergeants and roundsmen who can read a message from the dial at that rate of speed. The dial now in use is old-fashioned. It is about eight inches in diameter, the letters of the alphabet and the numerals being evenly divided along its outer edge. From the centre of this dial revolves a hand, like the hand of a clock, the index pointing to the letter or figure sent to be read. The new apparatus is an invention controlled by the Private Line Telegraph and Printing Company, and is now in use between Police Headquarters and the Mulberry and Elizabeth street stations of New York City.

THE TELEPHONE.

Appleton, Wis.—The new long-distance telephone line now being extended from Joliet, Ill., to this city, will, it is expected, be ready for use by Oct. 1.

Boulder, Colo.—A new telephone circuit has been established here. It takes in Boulder, Louisville, Lafayette, Erie and Canfield, but does not embrace either Longmont or Denver.

LeRoy, N. Y.—The Bell Telephone Company is placing poles through here for long-distance telephoning. An arrangement has been made between the company and the board of trustees which allows the latter to use the poles for stringing electric light wires.

Montreal, Canada.—A meeting of the Directors of the Federal Telephone Company was held last week. Several of the directors, including the president, Mr. W. Cassills, resigned, and were replaced by the gentlemen representing the new stock. The latter are connected with the Bell Telephone Company. A director of the Federal Company denied that the two companies were amalgamating. He said that was impossible. He called it a partial change in the ownership of the stock.

THE ELECTRIC LIGHT.

Salina, Kan.—The two local electric-light companies have consolidated, with better service as a result.

Red Oak, Ia., is again agitating the electric light question. A franchise for a local plant has been granted.

Chehalis, Wash.—The electric light plant, after long delay, was put in operation for the first time last week. Great satisfaction was expressed by the citizens.

West Union, Ia., is to have an electric light plant. The station is to be operated by a private corporation, the municipal ownership of plants not being favored in West Union.

Ellicott City, Md.—The proposition to establish an electric light plant is meeting with the co-operation of the majority of the citizens, and it is expected that definite plans will be made before fall.

High Point, N. C.—E. A. Snow and J. E. Cox were recently appointed by the City Council to purchase an electric light plant for the city. These gentlemen are now ready to receive bids on an electric light plant of about 50 arc lights capacity.

Schuylkill Haven, Pa., has decided to illuminate the town by electricity. The Thomson-Houston Company, which has the contract for furnishing the light, has begun placing the plant. It is expected that the lights will be ready for use within 30 days, while the town in the meantime will be in total darkness.

Narragansett Pier, R. I.—A disastrous fire at the electric light plant has caused the resort to go back to the use of kerosene lamps. The principal hotels, however, are struggling along with their gas machines. The damage to the plant is said to be $25,000. The plant, having been fully insured, will be rebuilt at once.

Bay City, Mich.—The electric light plant which was destroyed by fire recently is being rebuilt. A brick wall will be built between the engine and dynamo rooms as a precaution against fire in the future. It has been the intention of the company to build the party wall, but its beginning had been delayed until it was too late.

Wheeling, W. Va.—The electric light commission now visiting Cleveland, O., consists of P. F. Farrel, A. A. Trangheim, J. A. Campbell, Albert Capps, C. W. Kreiter, Charles Craig, H. H. Duniern, A. J. Schultz, William H. Shafer, J. W. Phoebis, William C. Beans, J. A. Seely and S. M. Darrah. The visitors are inspecting electric light plants in the city, and are the guests of Mr. J. E. Ridall, of Pittsburgh, representing a prominent electric light company.

Shenandoah, Va.—Mr. William A. Dunn has completed a contract with the Mayor and Commissioners of the town for the erection of an electric light plant. It is understood that not only will all the streets and public buildings be lighted with electricity, but nearly all the private dwellings in the place will be lighted in the same manner. Shenandoah is a comparatively new town, about 100 miles south of Martinsburg, W. Va., and has a population of about 2,500.

Brownwood, Tex.—The franchise for an electric light plant and street railway has been granted to the Brownwood Improvement Company, which has a capital stock of $100,000. The contract for the lighting plant has been let to Clower, Harris & Co., of Dallas, as agents for the National Electric Manufacturing Company, of Eau Claire, Wis., and the work will be started inside of 30 days. The contract for the railway has not yet been awarded but it is intended to begin the work inside of 90 days.

Baltimore, Md.—The conduits built for the Brush Electric Light Company, but which on account of legal technicalities the company cannot use, have been attached by the Sheriff of Erie County. The Brush company is the complainant, claiming $15,000 damages. The sheriff is now in possession of all the conduits and wires of the Cobb company in Buffalo, N. Y. George J. Sicard, counsel for the Brush company, says this step has been taken to obtain possession of the conduits without unnecessary delay.

Wilkinsburg, Pa., has long enjoyed the privilege of electric lights. Hitherto the supply has come from Brushton, but it has always been insufficient. An independent plant is now a necessity, so Wilkinsburg, Edgewoodville and Swissvale joined forces to have erected another plant for their special benefit at the other end of the town. The result is seen in that a plant has been put up in Edgewoodville of a capacity large enough to furnish electric light for the three boroughs. It is expected that it will be ready for operation by August 1.

Electric Lighting in Chicago.—At a meeting of the City Council last week it was stated that the outstanding work ordered by the Council for the improvement of the city's electric lights would cost $56,000, and that if this were paid the remainder of the appropriation would not be sufficient to maintain the plant for the rest of the year. Other projects are now pending before the Council which will require an expenditure of at least $45,000. Of the 922 electric lamps already lighted in the city 528 are in the West Division, 174 in the South and 220 are distributed on the North Side.

New Contracts.—The Weston Isolated Lighting Department of the Thomson-Houston Electric Company reports the following sales: Dornberg, Glick & Horner, of *The Leader*, corner Adams and State streets, Chicago, for a 14,000-watt incandescent dynamo, a motor and a fan motor; E. Rothchilds & Bros., one 17,500-watt 10-ampere arc dynamo, to be installed at their place, 20 Monroe street, Chicago; Wakefield Rattan Company, corner Robey street and Blue Island avenue, Chicago, one 400-light incandescent dynamo, and the University of Illinois, Champaign, Ill., one 18,000-watt alternating-current dynamo and appurtenances, for use in electrical laboratory.

Daily Output of Incandescent Lamps.—Since the decision in the Edison lamp patent case we have received a number of inquiries as to the probable daily production of incandescent lamps in this country. It was stated officially a few days ago that the weekly output of the Thomson-Houston factory at Lynn, Mass., is 25,000 lamps, and a careful estimate made by the president of one of the smaller incandescent lamp companies places the total daily production at 50,000. The same authority places the total annual consumption of incandescent lamps at three times the total number in use, that is, each lamp is renewed three times in a year. These figures would give the total number of incandescent lamps in use in the United States not far from six millions, which is probably higher than the actual figures by a million or more.

Equipment of a Pittsburgh Central Station.—The present equipment of the Allegheny County Light Company, of Pittsburgh, Pa., in all of its three stations consists of one 500 h. p. Corliss engine, three 250 h. p., two 250 h. p., one 150 h. p. and three 35 h. p. Westinghouse Standard engines, and three 300 h. p. and five 200 h. p. Westinghouse compound engines, making a total of 4,105 h. p. of engine capacity. These are used in the driving of eight 3,000-light, two 2,500-light, one 1,800-light Westinghouse alternating current dynamos, and three 500-light, three 300-light and five 100-light Westinghouse direct current machines, besides 21 60-light Brush arc light machines; making a total capacity of 33,700 incandescent lights and 1,260 arc lights. The first compound engine built by the Westinghouse Machine Company is still in use in one of these stations, and is giving as good service as could be desired.

Little Rock, Ark.—The city electrician has made the following report to the Council of the operating expenses of the electric light plant: "The number of lamps run from the 1st to the 29th was 115; on the 29th and 30th there were 125 lights on, making a run for the month of 18,446 light hours. There were used in this run 76,900 pounds of coal, 3,500 carbons, 33 globes, 30 quarts of cylinder oil, 15 quarts of dynamo oil, 10 pounds of waste, costing as follows:

Coal, 76,900 pounds	$109.59
Carbons, 3,500	35.00
Globes, 33	26.79
Labor, 5 men	345.00
Oil	5.80
Waste	80
Total expenses	$522.98

Making the running expenses per light hour for the month 2.8 per cent."

The Montreal Meeting of the N. E. L. A.—The Citizens, Committee of Montreal is vigorously pushing forward to completion the plans for the entertainment of the National Electric Light Association. The Corporation of the city has just voted the appropriation of a large sum of money, to be placed at the disposal of the Citizens' Committee. The use of quite a number of yachts has been tendered by private gentlemen of Montreal especially for the pleasure of the ladies attending. President C. R. Huntley, of the Association, informs us that a new feature will be introduced this year, as suggested by the Executive Committee, which will add to the interest and the diffusion of practical information on the details of work in connection with the operating of central station and other plants. A "Question Box" will be placed at headquarters in Montreal for the reception of written questions upon any pertinent subject. This box will be opened prior to each session, the questions read in open convention, and answers requested from those who are willing to speak upon the subject.

THE ELECTRIC RAILWAY.

Newburyport, Mass.—Five new electric cars have been purchased to take the place of those destroyed by the recent fire.

Winona, Minn.—Injunctions against using electricity for the city street railways have been dismissed, and the work of changing the line to an electric system will begin at once.

Wyoming, Pa., has granted permission for the building of an electric railway through the borough. The company building the road contemplates extending its tracks to Pittston, Pa.

Denver, Colo.—The Metropolitan Railway Company, which is the outcome of a consolidation of the several traction companies in the city, is to install an extensive system of electric railways to be completed before the coming winter.

Shrewsbury, Mass.—The work of laying the tracks, etc., for the new electric road is progressing rapidly. The tracks are being constructed in a most substantial manner, concrete being used between the rails, and the general character of the work through the system is of a high standard.

The Lockport and Olcott Beach Electric Railroad Company, N. Y., recently incorporated with a capital of $120,000, is to build an electric railroad, about 12 miles in length, from Lockport to and through the town of Lockport and Newfane, thence by the most direct route to the village of Olcott, on Lake Ontario.

Albany, N. Y.—A party of four directors of the Newark and South Orange (N. J.) railway visited the city last week and made an inspection of the workings of the Albany Railway Company's cars and power house. The directors are examining electric roads preparatory to substituting electricity for horse power on their line.

Pittsfield, Mass.—The electric road so long looked for was put in operation recently. The work of changing the old road from the horse system to the trolley system was accomplished in an extremely short time, and the company deserves great credit for the high standard of the finished installation.

Pittsburgh, Pa., Traction Business.—Reports from the city's several traction companies show that the following number of people were carried on Saturday of last week, the Duquesne, Central and Pleasant Valley roads having electric systems: Duquesne, 80,000; Pittsburgh, 70,000; Citizens', 50,000; Central, 11 000; Pleasant Valley, 35,000.

Milwaukee, Wis.—The grading for the Milwaukee-Wauwatosa rapid transit road is completed, the ties and iron are on the ground, and will be placed in position and the road completed by August 1. The electrical part of the outfit will require until September 1 to place in position, and on the latter date it is expected the road will be opened to the public. It is four miles in length.

The American Street Railway Association has just issued from the office of its secretary the verbatim report of the ninth annual meeting held at the Hotel Iroquois, Buffalo, N. Y., in October last. The work is prefaced by a handsome steel plate portrait of Mr. Thomas Lowry, president of the association, and president of the Minneapolis & St. Paul Street Railway Company.

Findlay, O., is jubilant over its new electric car system, which was put in operation for the first time a few days ago. Westinghouse single-reduction motors are employed and are working satisfactorily. Mr. Geo. B Kerper, of Cincinnati, O., well known in street railway circles, is president of the Findlay company, and is much gratified at the successful starting of the new line.

The Pleasant Valley Electric Railway Company, of Pittsburg and Allegheny, Pa., has declared a dividend of three per cent. to be paid from the earnings for the six months ending June 30, 1891. The financial report shows an increase of $20,357.85 in the business of these six months over that of the last six months of 1890. For the month of June, 1891, the receipts were more than $5,000 in excess of those for the month of June, 1890.

The First Electric Postal Line.—A correspondent has sent us a note to say that the statement that the Minneapolis & St. Paul Railway is to be the first electric postal line is an error, as the Newark (O.) & Granville Electric Railway has been a regular mail route for several months past. Another correspondent writes from Omaha to say that the Omaha & Council Bluffs Bridge Company has been carrying mail on its electric trains between those two cities for nearly a year.

Schenectady, N. Y.—The trial trip of the electric cars was made recently, and the road proved to be a complete success. The following well-known gentlemen were at the opening of the road: William B. Turner, W. E. Gilmore, David A. Mason, superintendent of electrical construction, Herbert De Camp; Aldermen Thomas W. Wallace. Gerardus Smith and Albert Shear; Recorder Martin Swart, Stephen A. Preckel, John E. Anger, superintendent of the Gilbert Car Works, Hon. John D. Campbell, Thomas Gunn, and Michael Leyden, superintendent of the Schenectady Gas Light and Electric Light Company.

Pittsburg, Pa., has passed an ordinance making it obligatory upon street railway companies to have their cars come to a full stop 20 feet from street crossings in cases where each of the cross streets is traversed by a street railway line. The passage of this ordinance was brought about by the fact that there had recently been an alarming number of collisions between street cars at these crossings, and in some cases these collisions were attended by loss of life. It is expected that in future no accident of this nature will take place, as there will be no possibility of such a happening if the provisions of the ordinance be carefully observed.

New Railway Power House at Pittsburgh, Pa.—H. L. Kruesler has been awarded the contract for the erection of a new power-house by the Citizens' Traction Electric Company. The building will be located on Plumber street, between Forty-seventh and Forty-eighth, directly opposite the old Transverse stables. It is to be a strictly fireproof structure, of stone, brick and iron. The cost will be $40,000, and will be two stories in height, and 94 by 125 feet. Sixty days is the time designated for its completion. At the present time a number of workmen are engaged tearing down the old building. The line will be known as the Shapsburg & Guyuasuta (Pa.) Electric Road.

An Electric Express Route.—The electric railway of South St. Louis has put on an express car for carrying small parcels between the centre of the city and the outskirts. A local paper says of the scheme: "A car for carrying baskets, boxes, parcels and all kinds of light freight will no doubt produce sufficient income to more than pay for the trouble and expense of handling the stuff; at any rate it would be a source of great convenience, not only to passengers but to others, as a person going to the city to make purchases can have them shipped home by the electric express and they be relieved of a burden which would otherwise be an annoyance to their fellow-passengers as well as to themselves.

GENERAL APPLICATIONS OF POWER.

Electric Drill Work in Washington.—Edison electric drills are now in use in great number in the construction of the Great Northern Railway from Grand Point, in Idaho, westward down the Pend d'Oreille River.

Electric Welding for Cable Roads.—The new Brooklyn, N. Y., cable road has made use o the electric welding machine in joining the sections of its cable and for other purposes with great success, the tensile strength of the welded cables being far greater than with the old methods of joining.

United States Coinage Presses Run by Electric Motive Power.—The Philadelphia Mint has installed an Eddy electric motor of 25 h. p. which is run by wires from the street. Lack of space has compelled Mr. James, the master mechanic, to utilize every possible situation, and now the establishment has fairly pushed itself through the roof, where the apparatus is situated under cover of a frame structure. Power is conveyed from the motor on a 12-inch pulley, making 1,050 revolutions a minute over a 6-inch belt to a pulley making 275 revolutions; thence to the machine shop, where the revolutions are reduced to 70 per minute, and last by a belt along the east wall to a shaft on the basement line which drives the coinage presses. A 2,000-pound hoisting machine and No. 8 Sturtevant fan, used in ventilating the front offices, will also be driven by the motor, which is designed for use while the steam plant is being repaired and in case of accident.

LEGAL NOTES.

Edison Company Sued.—Hon. Wm. Henderson has brought suit against the Edison General Electric Light Company claiming $35,000 damages. The plaintiff held a contract with the Broad Ripple Rapid Transit Company to place $30,000 of its mortgage bonds. The Broad Ripple Railway Company contracted with the Edison Company to build its lines. Operations were suspended, and the defendant makes the Edison Company a party to his contract.

The Pittsburgh Aluminium Reduction Company has been defeated in its attempt to prevent the Cowles Electric Smelting and Aluminium Company from manufacturing aluminium. Last week, Judge Ricks, of the United States Court in Cleveland, O., handed down a decision to this effect. This is regarded as a decided victory by the Cowles Company. Judge Swan is to hear a motion by the Cowles Company to extend the time for taking testimony in a suit for infringment. The Pittsburgh Company had secured an injunction some time ago against the Cowles Electric Company, restraining the latter from manufacturing aluminium and selling below the market price.

Judge Wales Decides the Delaware Telephone Case, Wilmington, Del.—Judge Leonard E. Wales last week handed down a decision for the relator in the United States Circuit Court in the mandamus case of the Postal Telegraph Cable Company against the Delaware & Atlantic Telegraph and Telephone Company. This is an application for a writ of mandamus to compel the respondent to place a telephone transmitter and receiver in the office of the relator on the same terms that are given to other subscribers. The Postal Company's petition was originally filed in the Superior Court, and was taken to the United States Circuit Court on an order from the Superior Court, on the ground that the question for decision, which was how far a patentee is entitled to control the use of his patent, was one which should be determined under the laws and Constitution of the United States.

Electric and Gas-Fixture Infringement Suit. In the case of George Maitland vs. Alfred C. Gibson, doing business in connection with The Gibson Gas Fixture Works, an infringement suit which was noticed in THE ELECTRICAL WORLD of July 4, 1891, Alfred C. Gibson, through his attorney, Theodore F. Jenkins, has filed an answer to the complaint of George Maitland in which he denies all the allegations of the complaint, that he is in any way infringing the patents specified in the bill. He further says that "a large number of the manufacturers of gas and electric-light fixtures have formed an unlawful combination under the name of The Gas and Electric Light Fixture Manufacturers' Association, for the purpose of illegally controlling the manufacture and sale of gas and electric-light fixtures in the United States"; and that "the bill in this case was filed not for the apparent purpose of an honest prosecution of a supposed valid claim, but for the purpose of endeavoring to coerce the defendant into joining the said unlawful combination."

PERSONALS.

Mr. Astley C. Terry, of Buffalo, N. Y., was in New York City last week.

Mr. J. H. Rhotehamel, president of the Columbia Incandescent Lamp Company, of St. Louis, Mo., was in New York City on business this week.

Mr. J. C. R. Peabody, with the banking house of Messrs. E. Rollins Morse & Bro. for several years, has taken charge of a new department of the Thomson-Houston Electric Company.

General C. H. Barney has resigned his position as treasurer of the Alexander, Barney & Chapin corporation and retired from the organization. The new treasurer is Mr. Henry Alexander, brother of the head of the firm.

Mr. James O'Brien, for some time traveling salesman for the Southern Electric Supply Company, has become associated with the St. Louis Electrical Supply Company, of St. Louis, Mo.

Mr. Charles A. Schieren sailed on Thursday of last week on the "Fuerst Bismarck" for a short trip to Europe. The principal object for his going abroad is to attend the International Electrical Exhibition at Frankfort, where he will inspect the various devices for transmitting power by belting.

Mr. Edgar W. Mix, who has been in Europe for nearly a year on business for the Thomson-Houston Electric Company, is now on his way home. Among other interests which Mr. Mix has been looking after abroad were those of the Thomson-Houston watt meter at the Paris meter competition.

Mr. Edward D. A. Brady, an electrical engineer and contractor, whose office is at 56 West 116th street, New York City, has received the appointment of electrical engineer for the Frackville & Gilberton Electric Light and Power Company, of Frackville, Pa. This company is to put in an extensive electrical plant, of which Mr. Brady will have entire charge.

Mr. Charles J. Van Depoele, of the Thomson-Houston Company's works at Lynn, has started on a circuit which includes New Orleans, Chicago and Washington. His object, according to a local paper, is to do work on his interference cases, in connection with his 50 or more electric railway patents. Mr. Van Depoele is credited with something of the patience of Job. Within a few months five interferences have been decided in his favor, and he has 19 yet to be heard. His assistants in his electrical work, who must be called as witnesses, are scattered from Maine to California.

MISCELLANEOUS NOTES.

The Edison General Electric Company is erecting four large additional buildings for the Bergmann Chandelier and Electrical Fixtures Company at Schenectady, N. Y.

The Electrical Forging Company, of Boston, Mass., carried out some very interesting experiments at its works last week. Mr. W. E. Quimby, of Detroit, Prof. Langley of the Smithsonian Institute, Prof. West of the Crescent Steel Works, of Pittsburgh, Pa., and a number of gentlemen from the Boston Navy Yard were present and witnessed the experiments.

Boston, Mass.—A meeting of the Cambridge committee on police was held last week at the mayor's office, City Hall, for the purpose of considering the bids of the Gamewell, Municipal and Davis police signal companies for extending the system to East Cambridge. The matter was given a thorough discussion, representatives of the companies being present and explaining the merits of their respective systems. The contract will be awarded later.

A Directory of Steam Specialties and Engineering Appliances has just been issued by A. J. Hewlings, 218 Lake street, Chicago. The book contains 240 pages, and is substantially bound, well printed, and, as its name indicates, contains full lists of all manufacturers and dealers in steam supplies and engineering specialties. The principal object of compiling the book is stated to be to include complete lists of all the manufacturers of specialties under respective headings. The work will prove a useful addition to the office of any company using engines or steam machinery of any kind in its establishment.

A New Use for Porcelain Insulators.—A member of the English Institution of Electrical Engineers has recently made a unique and highly interesting present to that body. He is stationed in Australia, and has been running telegraph lines through the interior, where the natives swarm. These natives have hit upon the fact, in some way, that the porcelain knobs used as insulators on the telegraph poles make excellent spearheads when ground down for the purpose, and the consequence is that the demand for new insulators is abnormally large. He has sent some of the spears to England. They are about nine feet long, and it is said that the natives have shown remarkable ingenuity in bringing the porcelains to a very fine, sharp point without splitting or cracking them.

Industrial and Trade Notes

The Eclipse Clutch Works, Beloit, Wis., is well equipped to take care of the heaviest class of work, and has added many first-class machinery tools, planers, boring tools, etc., and has a Shaw electric crane of 15 tons capacity traveling the length of the main shop.

Mr. W. S. Chesley, of 136 Liberty street New York City, reports large sales of telegraph instruments, including relays and sounders, as well as other electrical apparatus. He is doing work that is of special interest to electrical instrument and novelty companies.

The Sperry Electric Mining Machine Company, Chicago, will probably have an extensive display at Montreal provided it can find time to prepare the exhibit. Of late the company has been crowded with orders for heavy machinery, including generators and coal cutters.

The Electrical Supply Company, of Chicago, Ill, which has been appointed Western agent of the Stanley Electric Company, of Pittsfield, Mass, has issued a handsome pamphlet descriptive of the Stanley transformer. The pamphlet shows the efficiency and weight of this transformer to stand at the top of a number of its competitors.

The Jenney Electric Motor Company, of Indianapolis, Ind., has issued a little pamphlet giving illustrations and descriptions of the electric lighting and power apparatus and dynamos for electrotyping, electroplating, etc. The last page of the pamphlet contains a list of about 70 industries in which the Jenney electric motors are in use.

The Law Telephone Company recently received by steamer from Hamburg 10 casks of sal ammoniac, an analysis of which shows that it is 99.85 per cent. pure, and is entirely free from lead and iron. One year ago the Law Telephone Company agreed to take the entire output of the manufacturer in Hamburg, and since that time has been doing as it agreed.

The American Leather Link-Belting Company is exhibiting at the International Electrical Exhibition at Frankfort an American leather link belt which is attracting considerable attention, and it is said that it has proved so much superior to all European link belts exhibited that the other exhibitors have with drawn their link belts from the exhibit.

The Eddy Electric Manufacturing Company, of 136 Liberty street, has the honor of installing the first electric motor for the manufacture of government coin. The motor is of 25 h. p. and is placed at the top of the Mint Building, in Philadelphia, Pa., and is connected by belting to the coinage presses below. While there are many good electric motors there are very few motors which make barrels of money for the operating parties.

The Rollins Engine Company, of Nashua, N. H., has issued a pamphlet describing the Rollins automatic cut-off engines, and giving illustrations which show very clearly the general construction and method of operation of the engine. The value of the book is increased by the table of dimensions of the engines manufactured by the company and the tables for computing the economy and water consumption of non condensing engines.

The Brown & Sharpe Manufacturing Company, of Providence, R. I., has issued another of its treatises "On the Construction and Use of Universal and Plain Grinding Machines." The portion of the work devoted to the description of the manner in which the machines are cared for and used, and the examples of the different methods of grinding, has been very much enlarged. The book will be of value to all users of machines of this character.

Another Silver Medal for the Clark Electric Company.—At the fourth annual exhibition of the Amateur Photographers' Society, of New York, held in May, 1891, the Clark Electric Company was awarded a silver medal for excellence of its arc lamp for electric optical lantern apparatus. This is the first and highest medal ever issued by this society for electric light for optical purposes in photography. This opens up another channel of usefulness for the Clark apparatus.

The Hazelton Boiler has had steadily increasing sales during the many years that the Hazelton Boiler Company has been in business. Many electric light stations throughout the world are fitted with Hazelton "porcupine" steam plants, and it is claimed the sales of this boiler have doubled in each succeeding year. The extensive shops of the Hazelton foundry at Avenue D and Thirteenth street, New York City, are fitted with the very best machinery and tools to be found for the manufacture of high-pressure steam boilers. A catalogue recently issued by the company shows photographs of a number of recent installations of the Hazelton "porcupine" in electric light plants.

The Ball & Wood Company, builder of the Ball automatic cut-off engines, has issued a very handsome catalogue, in which are given full descriptions and illustrations of both the horizontal and vertical types of the new Ball compound and simple engines. The illustrations and descriptions of the details of the governor are especially satisfactory, and the same might also be said of that part of the catalogue which describes the valve gear of the engines. The company's principal office is at 15 Cortlandt street, New York, and its works are at Elizabeth, N. J. The new vertical engine of this company, which is shown in this catalogue, was illustrated and described in the columns of THE ELECTRICAL WORLD of July 4, 1891.

The Chester Manufacturing Company, of 53 State street, Boston, is just placing on the market the Appleyard patent safety fender for electric street cars. The fender is at the front of the car, and projects forward from the platform about four feet, with its lower edge about nine inches from the track. It is adapted to receive and hold the body of an individual or animal that may be caught upon the track and carry it along without injury. To guard against the possibility of injury to the person falling into the receptacle by the breaking of the rope net a second wire netting is attached to the lower portion of the platform. As an additional means of safety a scoop is placed beneath the body of the car, so that should a child fall on the track in front of the car and pass under the first fender it would strike a lever which would release a powerful spring and cause the scoop to come down upon the track.

Messrs Milliken Bros., of New York and Chicago, have lately gone to a great deal of expense and trouble to have complete tests made at Cornell University of their patent poles showing ultimate strength, elastic limit and corresponding deflection, in connection with standard pipe and wooden poles. They are now prepared to show the results of the above tests, which, it is claimed, give the Milliken pole an uppermost place. In the line of iron-roof work, of which this firm makes a specialty, it has recently secured several contracts for Allentown, Pa., for the new electric line, for a large boiler-house at New Orleans, La., and for a power-house equipment, Newark, N. J. The company has secured contracts for its patent poles for the new electric line in New York City and at Providence, R. I. Both these contracts are large and desirable. At the suggestion of Mr. McIntire this firm has introduced a new form of eyebolt in tops of poles which contains an additional insulator. It is made in the form of a fork, having a special porcelain insulator in end.

The New Works of the Berlin Iron Bridge Company, of East Berlin, Conn., are now completed; the company has all the machinery placed and is now running full time, employing in all departments 400 men. The new shop in Cromwell is said to be one of the most complete and perfect shops in this country. The building is entirely of iron, no wood work being used about the construction except for the window sashes. The roof trusses are all provided with trolley cars with which to move material back and forth about the building, and three lines of narrow gauge tracks extend the entire length of the building, these three tracks being connected at each end of the building by a transfer table. There is a skylight on each side of the roof, extending the whole length of the building, and for a distance of 10 feet down from the eaves of the building on all side it is made entirely of glass, so that the interior of the building is thoroughly lighted. The company has purchased a large amount of new machinery, and is now prepared to furnish all kinds of structural iron work, including iron buildings, iron roofs and iron bridges, on very short notice.

Jenkins Valves.—The New York *World* of a recent date, in describing the mechanical equipment of the World Building, had this to say of the Jenkins valves: "The selection of the best form of valve to use on the engine connections, heaters, boilers, pumps and radiators was a source of much consideration, since so much of the comfort of the tenants and staff of the *World* would depend upon the choice made. Finally the engineers employed were instructed to make a thorough test of the most popular valves. They reported in favor of the Jenkins Brothers valves and indicated the following as their points of superiority: They are perfectly tight under all pressures of steam, oils and gases. The seats are not injured by grit. Repairs do not necessitate their removal nor call for more skill than is possessed by the ordinary mechanic. The metal and workmanship are the best and all the parts are interchangeable. As a consequence of this report there are now over 1,500 Jenkins valves ranging from ¼ to 12 inches in the building. They have now been tried for several months and their practical working fully bears out the report of the engineers who recommended their adoption and also sustains the worldwide reputation which the Jenkins Brothers valves have earned."

The Electric Merchandise Company, of Chicago, Ill., was represented in New York last week by Mr. W. R. Mason, general manager of that company. Mr. Mason informs us that his men—and he thinks he has good ones—have lately sent in a most encouraging lot of contracts for the equipment of new roads. This company, it will be remembered, confines itself strictly to the railway business, and for this reason it is looked upon as an authority on electric railway matters. Mr. Mason was accompanied on this trip by some of the leading officials of one of the largest steam roads, who have decided to use the Burton electric heater on some of the vestibule trains on their system, intending to give it a thorough trial, and then equip the entire system with it. As details of an electrical nature had to be arranged a conference was had with Mr. S. Dana Greene, who is the consulting electrician of the Burton Electric Company, and final arrangements were then made. The company is to be congratulated on being the first to practically solve the problem of properly heating railroad trains by a means which avoids any danger from fire in case of accidents. As was noticed in THE ELECTRICAL WORLD last week, the Burton company has also secured the opportunity to equip some of the electric cars on the West End Street Railway, Boston, with its heaters. After renewing his old acquaintance with the ocean by a dip at Coney Island Mr. Mason returned to Chicago.

Business Notices.

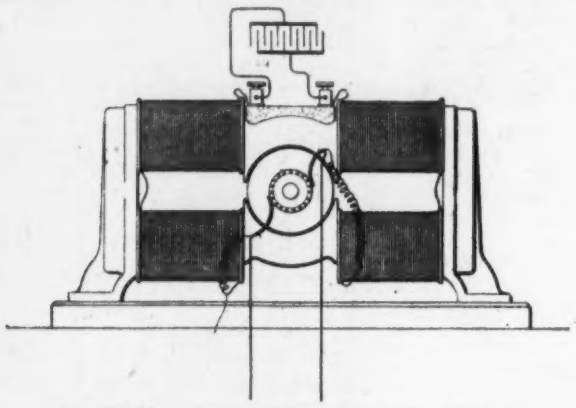
Delightful Resorts.—Our readers who are desirous of finding pleasant places to spend the summer should bear in mind that the Chicago & Northwestern Railway furnishes every facility for a rapid, safe and comfortable journey from Chicago to Waukesha, Madison, Lake Geneva, Neenah, Marquette, St. Paul, Minneapolis, Duluth, Ashland, Lake Minnetonka, Yellowstone National Park, and the mountain resorts of Colorado and the far West. Fast vestibuled trains, equipped with reclining chair cars, parlor cars, palace sleeping and dining cars, afford patrons of the Northwestern every luxury incident to travel by a first-class railway. Excursion tickets at reduced rates and descriptive pamphlets can be obtained upon application to any ticket agent, or by addressing W. A. Thrall, General Passenger and Ticket Agent, C. & N. W. R'y, Chicago, Ill.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

U. S. PATENTS ISSUED JULY 14, 1891.

455,747. Loop-Switch; William M. Goodridge, of Highland Park, Assignor to the Western Electric Company, of Chicago, Ill. Application filed March 4, 1887. In a sloop-switch, the combination with the handle of a cylinder of insulating material, two springs mounted near their centre, one upon each end of the cylinder, insulated contact pieces included between one pair of opposing ends of the two springs, and other insulated contact pieces adapted to be included between the other pair of opposing ends of the two springs when the handle is moved to the proper position.

455,763. Subway and Connection for Electric Railways; William Osner, of Chicago, Ill. Application filed Oct. 13, 1890. A subway for electric railways comprising, with the track rail, a supplemental rail or bar having a bearing upon the foot of



NO. 455,773.—ALTERNATING CURRENT MOTOR.

the track rail and clamping plates, whereby to secure conductors forming parts of an electrical circuit or circuits to one of said rails, said rails being so positioned as to provide between them a continuous slot for the passage of a connector between the motor and the conductors.

455,765. Electric Motor; Harry H. Porter, of New York. Application filed Jan. 17, 1891. In an electric motor, the combination, with two pole pieces, of a three-pole armature having two or more parallel sets of radial magnet cores, and coils for said cores connected into a closed circuit, and connections from intermediate portions of said circuit to the segment of a three-part commutator.

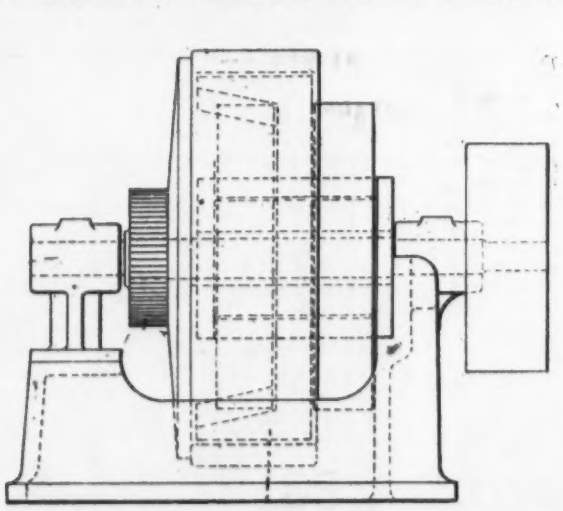
455,773. Alternating Current Motor; William Stanley, Jr., of Pittsfield, Mass., and John F. Kelly, New York. Application filed April 10, 1891. The invention consists of an electromagnetic motor provided with a commutator and having its field and armature circuits in derivation, of a condenser included in the circuit having the higher self-induction. (See illustration.)

455,788. Thermostat; Henry A. Chase, Boston, Mass. Application filed Oct. 29, 1888. In accordance with this invention the circuit-changing lever of the thermostat is normally pressed by a spring against a block of paraffine or other suitable material, which melts or changes its condition at a certain temperature to permit the spring to descend and move the circuit-changing lever. The circuit-changing lever normally bears upon suitable contacts maintaining the continuity of the circuit, and when moved passes over an insulated portion and again rests upon other contacts so as to effect a change in the condition of the circuit and thereafter restore it. A resistance coil is provided, which is short-circuited by the circuit-changing lever when the latter is bearing upon the contacts, but which is introduced when bearing upon the insulated portion to weaken the current.

455,789. Process of Manufacturing Insulated Conductors; Charles Cuttriss, of New York. Application filed Aug. 6, 1890. The method of insulating electric conductors which consists in applying to or winding on a conductor the loose fibers of a material such as cotton, and compacting the same to form a felted or matted sheathing.

455,790. Dynamo-Electric Machine or Motor; Justus B. Entz, of New York. Application filed Nov. 24, 1890. In a dynamo-electric machine or motor the field-magnet system consisting of two coils of wire on a single core and two sets of pole-pieces, one set connected with the ends of the core and the other set connected with the core at a point or points intermediate of the coils, and an armature subjected to the influence of said pole pieces. (See illustration.)

455,796. Electric Railway; Rudolph M. Hunter, of Philadelphia, Assignor by mesne assignments to the Thomson-Houston Electric Company, of Boston, Mass. Application filed May 22, 1886. In a system of tepherage, the combination of a conductor divided into sections, switches which normally bridge from one section to the other, traveling trains or vehicles by which they are driven, and devices operated by the trains or vehicles to move



NO. 455,790.—DYNAMO ELECTRIC MACHINE OR MOTOR.

said switches successively and divert the current through the motors on said trains or vehicles, so that the motors are connected in series through the divided conductors.

455,798. Trolley for Electric Cars; Walter H. Knight, of Newton, Mass. Application filed April 8, 1891. This invention consists in providing a bell whose hammer is actuated mechanically by the movement of a trolley arm when it is thrown up by the spring on leaving the wire.

455,800. Electric Cut-off Apparatus; Edwin Wilbur Rice, Jr., of Lynn, Mass., Assignor to the Thomson-Houston Electric Co., of Connecticut. Application filed Dec. 15, 1886. In a circuit closing device for an electric circuit, having a series of contacts separated by an insulating film with a device traversed by the current of said circuit, whereby upon the separation or rupture of the circuit through said device an arc is established in proximity to the insulating film, so as to burn or destroy the film and allow said contacts to come together.

455,808. Electromagnetic Ore Separator; Jonas Wenström, of Orebro, Sweden, Assignor by direct and mesne assignments of two-thirds to Olof Wenström and William W. Manning, of Marquette, Mich. Application filed Dec. 24, 1890. A feed mechanism for magnetic separators, provided with devices for repeatedly presenting material to the same magnetizer during its passage through the machine.

455,809. Magnetic Separator; Jonas Wenström, of Orebro, Sweden, Assignor by direct and mesne assignments of two-thirds to Olof Wenström and William W. Manning, of Marquette, Mich. Application filed Dec. 24, 1890. In a magnetic separator the combination, with suitable armatures, of a magnet for said armatures, and means whereby the distance between said magnets and armatures may be varied.

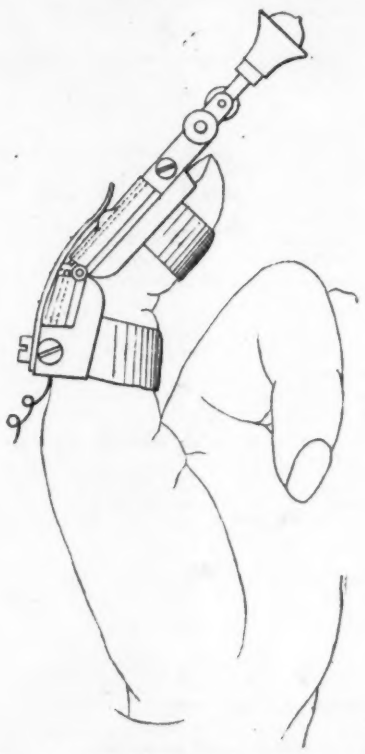
455,812. Fire-Alarm Apparatus; Henry A. Chase, of Stoneham, and Howard F. Eaton, of Cambridge, Mass. Application filed July 28, 1887. In an electric circuit, circuit-changing devices constructed and arranged to change the condition of the circuit and thereafter restore it, a single receiving relay and armature lever therefor, and motor mechanism controlled by said armature lever, combined with two receiving or indicating instruments, the operation of one of which is governed by the motor mechanism when the armature lever is moved in one direction and the operation of the other of which is governed by said motor mechanism when the armature lever is restored to its normal position

455,813. Thermostat; Henry A. Chase, of Boston, and Howard F. Eaton, of Cambridge, Mass. Application filed Nov. 1, 1888. In a thermostat, two independent levers and co-operating contacts, one of the levers normally resting upon or against its contact, combined with two independent cooperating devices, each sensitive to a rise in temperature of a different degree.

455,815. Electro Phonometer and Phonoscope; Isaiah Farnham, of Wellesley, Assignor to the New England Telephone and Telegraph Company, of Boston, Mass. Application filed Feb. 13, 1891. The method of comparing disturbing currents in electric circuits, which consists in causing them to vary the field of a magnet pole exercising attraction upon a vibratory diaphragm, in noting the sounds produced by the said diaphragm under said variation, and then in withdrawing the said currents gradually from said pole until the said sounds cease, and noting the extent of separation.

455,837. Electric Switch; Carl Georg Dahlgren and John Hugo Svensson, of Gothenburg, Sweden. Application filed Dec. 24, 1890. According to this invention the moving contact plate is adapted to be brought into contact with or out of contact with the fixed contact plate by means of a spring which, normally not in a state of tension, is tensioned in the one or other direction by the turning of the turn button.

455,855. Electric Indicator; Earl C. Eldredge, of Springfield, Mass. Application filed Feb. 9, 1891. The combination of an electromagnet having curved pole pieces formed in the segment



NO. 455,972.—ELECTRO MEDICAL LIGHTING APPARATUS.

of a circle, with an armature bar pivotally arranged to traverse the lines of said pole pieces and means to move the bar backward to its normal position.

455,856. Holder for Carbon Brushes of Commutators; Clarence H. Farrington, of Milford, Mass. Application filed Oct. 21, 1890. The holder of this invention is composed of arms hinged together, and one arm to be fixed as desired, and the other arm free to be swung on said fixed arm, and said swinging arm and constructed and adapted to receive the brush and to force it endwise and with yielding pressure into contact with the commutator of the motor or generator.

455,873. Signaling Apparatus; Howard F. Eaton, of Quincy, Mass., Assignor to George W. Gregory, of Boston, Mass. Application filed Sept. 23, 1889. The invention consists of one or more signaling transmitters and a signal-recieving relay connected by an electric circuit, the said transmitters being constructed and arranged to change the condition of the circuit for intervals of different duration, and a register contained in a local circuit governed by the armature of said signal-receiving relay and a bell contained in another local circuit but governed by the same armature, and a retarding device for the armature, whereby it is caused to differentiate.

455,887. Armature for Dynamo-Electric Machines; Edwin Wilbur Rice, Jr., of Lynn, Mass., Assignor to the Thomson-Houston Electric Co., of Connecticut. Application filed March 21, 1891. The combination, with a ring armature having its coils wound through the ring and supports therefor engaging with its core, of two or more separate segmental coil-supports bearing against the inner side of the coils and radially adjustable. (See illustration.)

455,898. Electric Motor or Dynamo-Electric Machine; Charles G. Curtis, of New York. Application filed March 9, 1891. A field magnet for an electric motor or dynamo-electric machine, having a rigid reel or form of waterproof material, a coil of wire wound on said reel or form, and a rigid waterproof shell or casing covering the coil, with means for making the joints between the reel or form and the shell or casing water and oil tight.

455,904. Insulated Electrical Conductor; Edwin D. McCracken, of Alpine, N. J., Assignor to the Norwich Insulated Wire Company, of New York. Application filed March 5, 1891. An electrical conductor having an insulating tape wound thereon in an open spiral, said tape being formed of twisted paper or paper cord flattened.

455,953. Cut-Out for Arc Lamps; Chas. E. Scribner, of Chicago, Ill. Application filed Nov. 4, 1890. The invention consists in placing the electromaget controlling the circuit closer of the shunt or cut-out circuit in a shunt simply around the lifting magnet of the lamp, this shunt circuit around the lifting magnet being automatically closed and opened by the mechanical action of the feeding mechanism.

455,955. Lightning Arrester; Charles S. Van Nuis, of New Brunswick, N. J., and Jonathan H. Vail, of New York. Application filed Oct. 16, 1890. The combination, in a lightning arrester, of a turning drum, a motor therefor, fusible conductors at intervals around the periphery of the drum connected at one end of the drum to lightning arrester plates, and connected at the other end of the drum to a line-terminal wire, a co-operating lightning arrester plate supported adjacent to the end of the drum carrying the plates, and a detent for the motor operated by fusing of a wire and permitting the drum to turn to bring a new fusible conductor and lightning arrester plate into operative position.

455,956. Electric Railway System; Samuel P. Wilcox, of Elkhart, Ind., and Jos. D. Partello, of Rochester, Mich. Application filed June 16, 1890. In an electric railway system the combination of two electrical conductors forming the main electrical circuit, a series of disconnected conductors, a cylinder for each disconnected conductor, each cylinder having electrical connection with one of the disconnected electrical conductors, each cylinder being journaled in suitable supports and having electrical conductors within the cylinder adapted to be brought together and separated by the rotation of the cylinder, and means for rotating the cylinder.

455,968. Secondary-Battery Plate; John Rosborough McLaughlan, of Philadelphia, Pa., to Simon Miller, of same place. Application filed June 3, 1890. A secondary-battery plate composed of opposite end bars and transverse connecting bars, all of aluminum, said connecting bars being of hollow trough-like form with inturned edges and adapted for the reception of the active material.

455,971. Armature for Dynamos; Frederick McGahan, of Indianapolis, Ind. Application filed Dec. 26, 1890. An armature provided with an external friction rim concentric therewith, such

NO. 456,120.—INSULATED ELECTRIC CONDUCTOR.

friction rim supported upon brackets bolted or secured to the body of the armature between the bobbins.

455,972. Electro-Medical Lighting Apparatus; Paul Oudin and Henri Othon Hratz-Boussac, of Paris, France. Application filed Oct. 13, 1890. The combination of an incandescent electric lamp, a section or support therefor mounted upon the extremity of the finger by a rubber band, a second section secured upon another joint of the finger by a similar band and contacts at the adjacent ends of said sections, whereby the circuit is completed through the lamp by flexing or reflexing the finger. (See illustration.)

455,981. Apparatus for Administering Electricity; Geo. Henry Bethel, of New South Wales, Assignor to the Bethel Electric Medical Baths Company, Ltd., of Melbourne, Victoria. Application filed Oct. 13, 1890. In an apparatus for administering electricity to the human body, the combination, with a cradle or support provided with an inclined back, of a vertically adjustable plate, adapted to be inserted in the water behind said inclined back and connected with any convenient source whence a supply of electricity may be obtained.

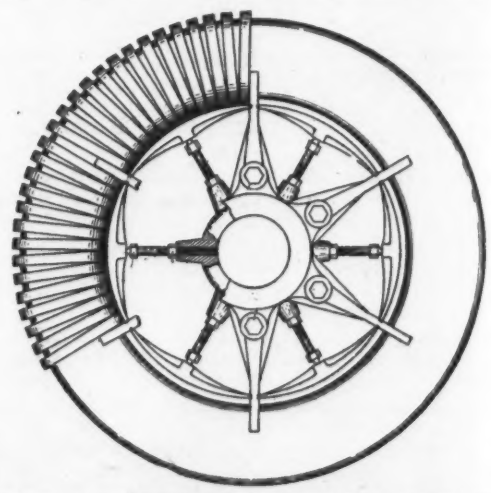
455,984. Magnetic Separator; Henry G. Fiske, of New York, Assignor to John D. Cheever, of same place. Application filed March 26, 1891. A magnetic separator provided with a centrifugal-acting feeding device for feeding the mixed mass of magnetic and non magnetic particles across the field on the under side of the magnets.

455,985. Magnetic Ore Separator; Henry G. Fiske, of New York, Assignor to John D. Cheever, of same place. Application filed March 26, 1891. A magnetic separator comprising a feed belt or conveyor, a transverse belt or separator crossing the feed belt a short distance above the same, and a series of magnets having their poles in close proximity to the separator, said poles alternating in polarity in the direction of motion of said separator;

455,986. Terminal for Electric Batteries; Hammond V. Hayes, of Cambridge, Mass., and Angus S. Hibbard, of Morristown, N. J., Assignor to the American Bell Telephone Company, of Boston, Mass. Application filed Jan. 19, 1891. A battery terminal connection dispensing with binding screws and consisting of terminal wires having one of their ends molded into or imbedded in the battery plates, respectively, and having their other ends coated by dipping or otherwise with easily fusible alloy for mechanically and chemically homogeneous attachment to circuit or instrument wires.

456,006. Street or Station Indicator; Wm. T. Snedden, of San Francisco, Cal., Assignor by mesne assignments to the Electric Street and Station Indicator Company, of same place. Application filed Jan. 14, 1891. A street or station indicator, comprising a card cylinder having a ratchet mounted on its shaft, a lever of the third order having a pawl pivoted on its end, a longer lever pivoted at one end and having its other end pivotally connected with the pawl-carrying lever at a point between the fulcrum of said lever and the pawl, an armature rigidly mounted on the pivotal connection of the two levers and electromagnets arranged to attract said armature.

456,021. Electric Belt; Lewis N. Fancher, of Kansas City, Mo. Application filed April 6, 1891. The combination of a cell formed with a copper core, an absorbent material surrounding the core, a copper plate passing on either side of said absorbent material, return bends in said copper plate, and a U-shaped zinc



NO. 455,887.—ARMATURE FOR DYNAMO ELECTRIC MACHINES.

plate engaging said outer copper plate and return bends in the same.

456,098. Street or Station Indicator for Cars; Geo. H. Tietjen, of San Francisco, Cal., Assignor of one-half to Geo. H. Bahrs, of same place. The invention involves the employment of an electric motor for actuating the mechanism by which the dropping of the cards is effected, and an arrangement whereby each falling card is made to stop the motion of the mechanism until the time arrives for another card to be dropped. An electric battery carried on the car supplies the current necessary to actuate the electric motor and operating mechanism, and the circuit is closed to start the mechanism into operation by a projection or obstruction on the track.

456,110. Automatic Circuit Closer for Telegraph Keys; Jas. W. Brown, of Van Wert, O., Assignor of one half to Augustus L. Sweet, Henry W. Blachly and John M. Tryon, all of same place. Application filed April 16, 1891. A circuit closer for telegraph keys having a finger piece secured by a vertical pivot to the finger button, and adapted to be moved horizontally upon said vertical pivot, so as to open the circuit, and a spring for automatically throwing the same in an opposite direction.

456,120. Insulated Electric Conductor; Edwin D. McCracken, of Alpine, N. J. Application filed March 4, 1891. The invention consists in laying parallel and in contact with the conductor threads or cords of insulating material, separated from each other to provide air spaces parallel with and next to the conductor, and over such threads applying insulating material to hold the cords in position. (See illustration.)